THE FOUNDRY

VOL. 13. DETROIT, MICH., DECEMBER, 1898. No. 76.

Dean Brothers' Steam Pump Works, Indianapolis, Ind.

The three photographs from which these engravings were made were taken in the foundry of Dean Bros.' Steam Pump Works.

No. 1 is a view in the brass foundry. At the left a portion of the molding bench is shown. At the right of it the door leading into foundry yard, farther to the right is a rattler for separating brass from cinders. At the end of the room is the pit containing seven brass furnaces, each capable of taking in a No. 100 crucible. Three workmen are drawing a crucible from furnace preparatory to casting. The floor of foundry is paved with brick.

No. 2 is a view in the iron foundry. The room is 60x100 feet. At the left is the core car that has been run from the core oven into the foundry. The car runs on iron rails so that it is easily transferred from the core oven into the foundry, and the larger cores may be taken off by a crane and placed in molds.

At the left of the car is the core-making room which could not be taken in the photograph.

At the right of core car are the cupola spouts. The cupola house is outside of the foundry. There are two cupolas, 35-inch and 40-inch, inside diameter, made by the Whiting Foundry Equipment Co.

Near the farther corner of the foundry is the door leading to the foundry yard. The next door to the right is the door to the brass foundry. The larger flasks shown in the foreground contain molds for large pump cylinders. The room is well lighted from three sides and sky lights.

FIG. 1—DEAN BROTHERS' STEAM PUMP WORKS.

No. 3 is a nearer view of the same room taken on a different day, with the workmen busy at their places.

The excellent quality of these views, showing distinctly and without a blur, so many men apparently busy at work, is very noticeable. They are going to pour that big mold in Fig. 1. The man with the skimmer at the right, and he with the hook at the left,

are alert and watching the lifting of the large crucible of molten brass from the furnace. Observe where the crucibles are kept—one row of them just back of the line of furnaces, and another on the shelf above, where no moisture or freezing cold can attack them. How light and airy the room looks!

See that fellow shoving a truck in Fig. 2, over there by the core car. Isn't he the same one that's rolling the wheelbarrow in Fig. 3? Look at the bellows leaning against the trunion of the large iron flask in Fig. 2. No danger of its being stepped on and getting the snout smashed, as often happens with careless molders who throw the bellows down anywhere on the floor.

Observe Fig. 3. We think Dean Brothers are in it. The elder one, over there to the left, in front of the cupola, is the only man in the room who seems to have his "hand in the boss' pocket!"—and he has only the left hand there. The young man in the straw hat, and watch chain on his vest, may be Mr. Dean, Jr. And now, how did they get so perfect a picture of these crowds? At the sound of a bell, every man stops motion, and maintains his position, whatever that happens to be, without the movement of a muscle, till the picture is taken and the signal sounds. These are high grade pictures, of a high-grade concern, as everybody knows who deals with the Dean Brothers.

FIG. 2—DEAN BROTHERS' STEAM PUMP WORKS.

Core Prints.

BY JOHN M. RICHARDSON.

The casting of metal in sand molds is of extremely ancient origin. Mention is made in scripture of Hiram, King of Tyre, casting pillars, and also various vessels and utensils of brass used in the forms of worship in Solomon's temple. This was about 1004 B. C., and it goes on to say that, "In the plain of Jordan did the king cast them; in the clay ground between Succoth and Zeredathah."

Now, as sand, or some form of earth, has been used for so many centuries for the mould in which to pour the molten metal, we can safely argue that where the patterns

used could not be made to draw their own cores, sand cores of some form made separately, must have been substituted and placed in the molds; and in order to do this there must have been some extraneous part on the outside of the pattern to serve as a core print, else the core could not have been properly set.

So we see that core prints and core boxes used so constantly every day, and which are in reality necessary evils, being used simply as a means for an end, and not showing in any way on a finished casting, are of high antiquity, although the art of coring may not have been discovered quite as soon as the simpler forms of molding.

A core print being merely to form a seat in the sand on which to rest or support the core, some relation must exist in regard to its length as compared with the core itself, and it must be sufficient to sustain the core without danger of crushing. When a core rests horizontally, one-half of the weight, or strain, is of course borne by each impression in the mold made by the print; and when set vertically, it about all comes on the bottom, the top merely steadying it—these conditions being previous to the pouring of the mold, the strain on the core by the metal not being considered here.

There are numerous kinds, or classes, of core prints, which have distinguishing features from the more irregular forms. Among them, I might name stock prints, heel or finger prints, and guide prints. The most common of all are stock prints, used, probably, a hundred to one of any other kind, and made to accommodate the stock cores in every foundry. There seems to be no standard for either taper or length of these, and it appears to me there ought to be; for we constantly see cope prints with hardly any taper at all, varying to those coming to a point at the top, like a cone. I know one jobbing foundry where the stock cores are made almost to a point at the top, and will consequently fit any print any pattern-maker can possibly make, as far as taper goes. I said "fit"; this hardly expresses it; "it is possible to use with" would probably

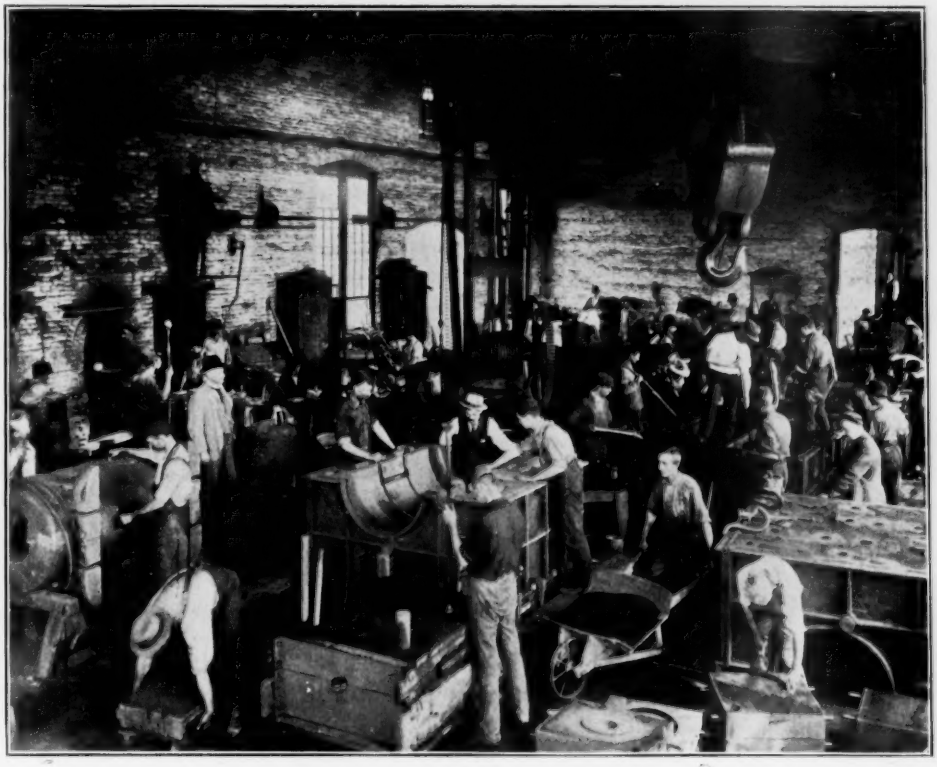
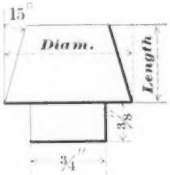


FIG. 3—DEAN BROTHERS' STEAM PUMP WORKS.

be nearer. But how much better to have the taper and length on each the same, and insure the core being held in position accurately; and how much more systematical to have the shank on all stock prints of ordinary sizes the same diameter, thus making them interchangeable from one pattern to another.

The appended list of stock prints is that used by one of the largest machinery builders in Rhode Island, and nicely fitted iron core boxes go with them, these being made of two half shells dowelled together, and the cores are rammed up whole, insuring a perfectly cylindrical core, with no pasting, and the taper on one end of box exactly matches that of the core prints. I would suggest that all dimensions on a list of this kind be in sixteenths or eighths, however, as thirty-seconds are hardly worth working to on prints.

Table of Standard Core Prints



Diam.	Length	Diam.	Length	Diam.	Length
3/4"	5/8"	1 5/8"	27/32"	2 1/2"	1"
7/8"	21/32"	1 3/4"	7/8"	2 5/8"	1"
1"	11/16"	1 7/8"	29/32"	2 3/4"	1"
1 1/8"	23/32"	2"	15/16"	2 7/8"	1"
1 1/4"	3/4"	2 1/8"	31/32"	3"	1"
1 3/8"	25/32"	2 1/4"	1"		
1 1/2"	13/16"	2 3/8"	1"		

The Foundry

Heel prints, sometimes called finger prints, are used when coring holes that come at a distance from the parting line of a pattern; or when the pattern is not parted, if at a distance from what would be taken as the cope line, and are usually of the form shown in Fig. 1, where it is necessary to core four round holes, "x, y," which fall at a distance from the parting line A B. These should have good taper on both sides, and also on the back, the latter being necessary to prevent the molder having any excuse for filing the end of the round part of the core, for with taper on the back, the core can be slid into position, and the round end will not scrape the mold while being set, but will just touch when the core bottoms in its seat.

What I should term a guide print is any ordinary core print with some certain part of it cut away, or else something added on to it, to serve as a guide to the molder, making it impossible to set the core in the wrong position, the core box being made, of course, to match the changed print.

Very many times a cope print is not necessary; but this must be determined by circumstances. If a hole is required to break entirely through a casting, and come clean, with no fin at the break, then both a cope and nowel print must be used; but if the hole comes through on what is to be a machined surface, and the core has sufficient width in proportion to its length to stand securely, then a nowel print is all that is required; for the cope rests on top of the core, helping to steady it; and if the hole should not break through quite clean, then it will come so when the casting is machined.

This will often save much time in making core boxes, and in turning taper prints for stock cores. When this is done, the outline of the core should be varnished in a different color on the cope side of the pattern, to indicate to the molder that the core comes entirely through. If a hole of any shape only goes partly through a casting, making it impossible to have more than one print, then have it of a good generous length, to make the core as secure in position as possible. This is especially necessary when a comparatively small core is

placed where a large body of iron flows all about it.

Oftentimes a core box and the print are made to exactly match in both length and breadth when it is not necessary; but on the other hand would be better if they did not. Take for instance Fig. 2, supposed to illustrate a pattern parted at A B. The core box must be the same width and thickness as the print to make the slot come true in the casting, but it is better to have the length of the core somewhat shorter, as "x, y," because it makes no difference to the

Fig. 1

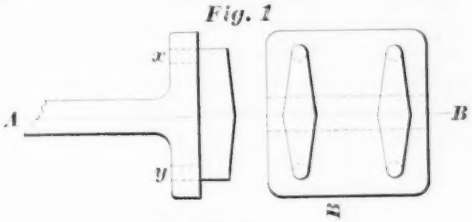


Fig. 2

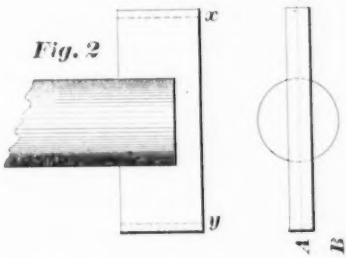
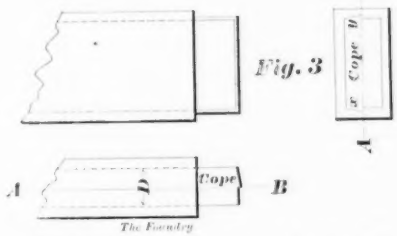


Fig. 3



casting if the core does not fill the mold endways, and it prevents any liability of the cope striking it when closing down, and the molder will have two less sides to file, to prevent crushing the cope. (I am taking for granted that an open frame core box with square sides, the thickness of the print, is to be used.)

Fig. 3 is an example where it is not intended to have the molder file the core to accommodate the cope, or to have the core box with taper to match it either. It will be noticed that the cope print overlaps the nowel on all sides, and the outline of the top where the taper commences is just equal to the nowel. In this case the core box is made the full depth of the core, shown at D, and just the length and width of the nowel prints; then, as the cope prints overlap those of the nowel, the mold cannot be damaged in closing down, and the core is held fast in position by the nowel. The only objection to this method (and it is hardly an objection) is, that the casting will show a fin at "x" and "y," which will be governed by the amount of taper given the cope print; but these fins will rapidly disappear under the edge of the cold chisel.

Another form of prints frequently used, although not, strictly speaking, core prints, are those to accommodate various rods, staples, or hooks of wrought iron, which are to be imbedded in the casting for various purposes. These have every appearance of ordinary core prints, and make the impression in which to set the wrought iron piece, precisely the same as though it were a sand core, the iron piece being usually either bent at the end or else having deep indentations made in it, made by a cold chisel, so that it may be firmly locked into the casting.

Occasionally, a certain place on a casting must have a chilled surface for some reason, and then the print on the pattern is to accommodate the chill instead of a core. About the only other pieces found on patterns which might be mistaken for core prints, are those placed there for stopping off purposes, and this subject I will not attempt to describe here.

Useful Foundry Hints.

A Building Column Which Broke Itself.

By R. D. MOORE.

When Robert Mallett was editing the Practical Mechanics' Magazine of London, a corrsepondent sent an inquiry with a sketch like Fig. 1, a piece of a building column, stating that it pulled apart at the collar while shrinking in the sand.

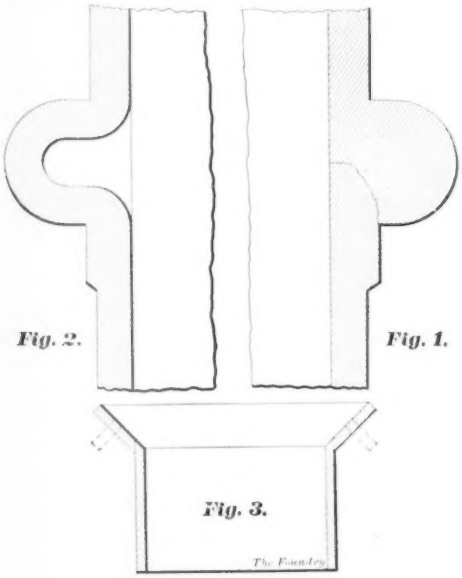
The reply given was: "Experience is the best teacher in such cases." I was surprised at the answer from a man who had been such a careful thinker and experimenter on foundry questions. He, I believe, was the first to give us the exact pressure of fluid iron on a mold from actual test; also that cast iron yields somewhat under shrinkage strain, and that a casting, a wheel for ex-

ample, becomes stronger by a few months' rest before using.

But this molder had abandoned experience, as it had failed. He needed a little philosophic gumption to grapple with the problem, when it becomes a very simple case. The designer had left a hot section in his traction train, contrary to law.

But how many merely experienced molders can solve this mystery? When the column commenced to shrink, or shorten, the gates and other projections resisted the pull somewhat, and the hotter and softer collar was too weak to stand the strain.

The solid collar (Fig. 1) not being thoroughly fed, through thinner sections, will



Coring Angular Holes

present a "draw" or honeycomb at its hottest center point, as shown; the crack will probably start at the hottest corner, determined by the little band added, and run through the weak shrink cavity, as shown by heavy line, following the weakest metal.

The remedy in this case is a very simple one: equalize the metal thickness, and thereby the time of cooling, when the strength will all be acquired uniformly. (See Fig. 2.) Our help does not end here; the column is greatly weakened, vertically, by the collar added to the core, and the casting should be stiffened by slots, or partitions, filed through the core collar about the thickness of the casting, say six or more in number, according to the diameter of column, and load to be sustained and reaching to the dotted line. The corners (Fig. 2) have no strength value; rounding them saves metal, besides adds a fraction to uniformity of cooling, the very object in view, as well as improving the shape of the core.

CORING IRREGULAR HOLES.

Cases sometimes occur where it is desirable to core bolt-holes, for economy, but being on a line varying from the draft line prints cannot be used conveniently. Such prints are often easily made by boring holes in the pattern at the proper points, the size desired, then after selecting a core-box of the proper length, making a pin with a shoulder to gauge the depth of the impression. Before drawing the pattern, take out of the holes the proper amount of sand with a lifter, then force in the plug with a rotating movement, when you have a set of prints both good and cheap.

This trick first occurred to me when a friend asked me to cast a collar for the top of a horse-power center-post (Fig. 3 gives a view, split), adding that he would like the bolt-holes for the sustaining rods, as shown, cast in, but that it could not be done, when I replied, "Fix your pattern as you wish it cast." I made the print plug and astonished him next morning with holes 45 degrees out of line with the draft line.

That device is applicable to a variety of jobs; furnace plates with angular flanges, curved or saddled flanges, etc., and not confined to bolt cores only.

Cast door frames for vertical boilers, that is, the plain frame riveted between the outer and inner shells, to form the door opening, and with a row of ⅝ rivet holes, was a case of angular coring that gave much trouble in their day to produce correct holes. That casting, however, has been generally condemned; they sometimes breaking under the riveting hammer, and wrought iron substituted.

What is the "matter" with cast steel kept on stock? Loose prints, enlarged to an inch diameter, with very short dowel pins, was the general mode, but that was not satisfactory, depending largely upon the molder's "eye" for correct holes.

My first experiment was to nail two true boards together, making a right angle, setting it on end against the core and pressing the core into the corner, which improved the correctness of the core setting very much, but taking much time, besides roughing the

mold. The following device was finally adopted and proved very satisfactory: Extend the drag side of pattern, say one inch deeper than the casting requires; then make boxes for flat cores to fill the extra depth with the rivet hole cores made fast, from two to four holes on each as they divide best

Boxes and cores are both easily made. The flat cores should be a trifle small all around to insure their dropping easily to their places; the tumbler will take care of all such fins.

Among the many advantages of this plan may be named, no core prints to be made, handled or to keep; very clean holes and true in their places, which no other system ever accomplished; a much smoother drag face and easy to mold, with very small danger of loss.

Feeding.

(Or the Compressing of Metals.)

By WM. ROXBOROUGH.

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The subject of feeding having attracted many practical men of late, both in this country and in the States, and notwithstanding all that has been written thereon I do not consider that the subject is at all exhausted. Although I have appreciated to the full all that has been written by practical men, still as a practical man I venture to extend on the subject principally on ground hitherto untouched by any of your contributors, as far as I have seen. While giving my views it is not my intention to seek to minimize the good that others have done by writing on this all-important subject, which should be equally interesting to all mechanics. While our methods of working must vary according to general conditions, which more especially apply to climate when viewed from a greensand point of view, still the law of expansion and contraction of metals is the same the world over. Thus we see that cause and effect in the matter of feeding is the same from any point of the compass.

To my mind the term feeding is exceedingly ambiguous, as it is so far-reaching inasmuch as it must apply to all that pertains to the solidification of metals; but to view it from the popular standpoint as it is generally regarded. The act of pumping or working with a rod of iron through some pouring or flow gate (commonly known as riser) in order to secure this particular part of the casting, which is generally the highest, free from "draw," such would certainly confine it to a very small space and it is to be regretted that so many molders, men of long years of experience, never see it beyond this narrow range of thought. This just brings to my mind an article which I read on this subject some years ago by what I regarded as a man of great and varied experience. After treating the subject in a general way and relating his experience he wound up his article neither for or against, he maintaining that he had seen as much evil attend the feeding of castings as any good he had ever seen it do. Perhaps there may have been a laxity of discipline here; at any rate there was either carelessness or want of intelligence, as I maintain that the feeding rod, when intelligently applied, is the crowning act to good and perfect casting. I cannot by illustration in such an article as this, give what I would require to show up the difference in certain parts of a mold which must of necessity be fed if a sound casting is desirable, but suppose for a moment that we are dealing with a mold having an average metal of two inches thick; then to such a mold there are attachments in the form of pockets, brackets or blocks four inches thick, and if we take it that the average metal, which is two inches thick, solidifies in five minutes, it is not unreasonable to expect that the attachments aforementioned will take double the time. Therefore, assuming the above illustration to be correct, and the general body, which is two inches thick, having solidified while the heavier parts, which are four inches thick, remain in a semi-plastic condition, these cannot set down or solidify without deteriorating their surroundings, and it is in such places that feeding becomes a necessity. Of course many may say that there are parts as shown here that are altogether out of the reach of the feeding rod. To this I assent, but where such does exist, and provided such parts are neither turned or polished, and that solidity is everything, and this is the case in heavy pump castings, which have to undergo a severe hydraulic test, very much good will result by a judicious interspersion of malleable iron or chaplets. No doubt there are abundance of castings which require no special treatment, but wherever disproportionate parts exist on a casting the surface of such may appear perfect to the eye, but

just as sure as they do exist, in and around these disproportionate parts the molecules of the iron become much larger and very frequently "draw," and sponginess abounds. (2) Before passing on to consider what may be appropriately termed position of casting, that is to say, whether a mold be cast vertically, horizontally, or on the declivity, I must deal with what influence certain brands of metal have to do with the soundness of castings. A metal that is soft and is said to be highly graphitic will not give the same amount of trouble in drawing as one that is dense. For any one who may have any doubts about this I would kindly advise such to look into the nature and habits of the finer metals and they will there have an object lesson. Metals shrink or draw in proportion to their density. Thus it is that No. 1 grey pig iron is soft and

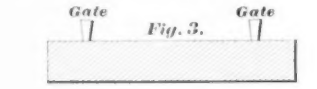

Fig. 3.

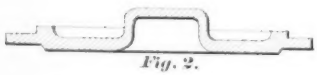
Fig. 2.

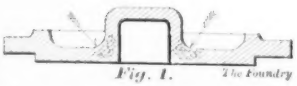
Fig. 1. The Foundry

Fig. 4.

shrinks least of all metals, at least so far as the term applies to machinery castings, and the further it moves towards the steely stage its shrinkage may be said to increase in the same ratio. Steel may approximately be put down as having double the shrinkage of cast iron, and when we pass into such metalloids as bronze, brass, antifriction metal and last, but not least, that metalloid known as speculum metal, which of all metals has increased shrinkage. In this particular metal, which for density I know no equal, the tendency to draw is so great that I have seen it at times commence to draw in the pouring basin, the oxidized or pasty surface of the metal breaking through in irregular form and working its way right down through the center of the gate and ultimately into the casting, and when an attempt was made at polishing, the lustre on this part was so imperfect that the casting was only good for breaking up. I think in the foregoing there is ample evidence to prove that metals shrink in proportion to their density, and what I have shown as being akin to those metalloids mentioned, the same action is at work with common cast iron, although in a less acute form. Further, on this particular branch of the subject permit me to say that very much depends upon the molder in securing a faultless casting, but it is not at all times within his reach to do so. The evil accompanying disproportionate metal to bring up a bright polish in finished work is neither due to the molder or the metal, but belongs exclusively to the designer of the castings. Fig. 1 shows what may be considered an absurd design, and round the flaked parts, as shown by arrows, are seen the molecules in a somewhat detached form. This detachment or non-density is caused through this part of the casting being last to set, and it is in such places as I have described that the misnomer dirty metal is frequently applied, and the best metal any molder could cast such a mold with would be insufficient to erradicate the error as described here.

Happily this state of matters is becoming every day better. Men are using cast iron with greater economy and have found out the necessity and benefit there is in rigidly adhering to, as far as practicable, a proportionate design throughout. I simply give Fig 2 as a contrast, and what I should say an ideal casting. The reader will observe that its thickness is proportionate throughout and that it is thoroughly homogeneous and entirely free from the defects so objectionable in Fig. 1.

(3) As regards position of casting, there are many who think that the vertical is the ideal position to secure a sound casting. While that is so far true and in many cases absolutely necessary it does not follow that perfection or uniform density is the result, as I shall clearly show before this division of my article is closed. Meantime I will take for an example an ordinary locomotive cylinder, which is cast on end, and what do we find in the top or gate end? And please observe that I do not go further in this matter than deal with this part of the casting. As soon as the sinking head (or dirt receptacle) is cut off I believe 19 cases out of 20 show more or less defectiveness, and to get a face absolutely perfect is almost

an impossibility, because in these days of spurious inspection if it should happen that such a face as I have described on top end of flange had two or three holes, each incapable of burying an ordinary green pea, one is in terror that such a casting will be condemned. Those defects as shown here are entirely due to its being cast vertically, but such is the prejudice of some to this position of casting their cylinders, and it is this trouble that has led many to cast in the horizontal and inclined positions, as by the adoption of these latter positions they entirely get rid of this chronic disease in sinking heads which has been the means of losing so much valuable work. I feel almost tempted to touch on the other points of importance pertaining to this casting, such as the valve face, barrel, etc.; however, I must keep to my promise and may return to this subject on some future occasion. Again let us look at the structure of a steel ingot casting, and what do we find at the top end? Nothing short of a multitudinous group of what are erroneously called blow holes. Of these so-called blow holes ninety-five in every hundred I believe are due to shrinkage. Of course this may be said to be an exaggerated view, from an iron molder's standpoint, but nevertheless it serves to show in a practical form how the top end of all vertical castings are thus weakened. This is a matter which will always accompany vertical casting, and is not likely to be cured unless some mechanical means be devised whereby a mold when cast vertically and before solidification is accomplished could be thrown into the horizontal position. This I readily admit to be more utopian than practical; all the same, what defectiveness is concentrated in top end of ingot casting, as previously stated, would be distributed over the entire length of ingot and in a greatly minimized form. To illustrate what may be appropriately termed gradation of structure I give two figures, Nos. 3 and 4, which will clearly show how structure in fluid metal is formed during the process of solidification. Although the figures are imperfectly given, I hope they will be sufficient for the purpose intended. As will be seen, Fig. 4 represents the vertical position and Fig. 3 the horizontal. In the horizontal position there may be said to be entire uniformity and the casting may likewise be said to be perfectly homogeneous throughout; at least as far as the naked eye can discern, although at the bottom side, if a scrutiny were made, the molecules are more compressed, in consequence of which there is greater density. Fig. 4 I have divided into six twelve-inch parts to illustrate the different gradations in every division, and by looking it will be seen why such a casting, cast in the vertical position, is defective in the top end. I have flaked and dotted the vertical position to illustrate as nearly as I can those cavity or vacuum holes which are sure to accompany vertical casting, and it lies with the molder how best to assist such a casting by the aid of the feeding rod or otherwise.

It seems almost superfluous that I should seek to explain how this is caused, as the illustrations no doubt will explain in a clearer way and with more force than my pen is capable of doing. However, I would like just to draw the reader's attention to the fact that Fig. 3, being cast in the horizontal position, there is only 12 inches in depth of mold, as against 6 ft., 10 in., in the vertical position, and as there may be said to be six times greater compression on the bottom of the vertical position as compared with the horizontal, therefore there is six times greater tendency to draw on the top end. Of course those cavities as a rule are not discernable to the molder in the majority of cases until a casting be subjected to machining.

I have often thought that the term shrinkage as applied to the formation of vacuum holes is at times ambiguous and frequently misleading. The popular view of shrinkage is to regard a fused metal as contracting towards its center, and this is so far correct, but with a fluid body which has resolved into what may be termed the semi-fluid condition there is really no center of contraction until disintegration takes place, which creates a dragging of the crystals and when once this is accomplished the whole body shrinks in uniform ratio towards the kernel or center. This, as has been described may seem somewhat strange, as many may look upon the center being the most dense on account of the force traveling inwards, but this cannot be so, as the outer shell cools first, and in the act of cooling densifies itself through deteriorating the kernel. Thus it is that all fluid metals are

more dense in their outer extremities and the atoms become more perceptible or less combined the further we move in the opposite direction.

What Some Men Are Willing to Become Foremen For.

By HENRY HANSEN.

A foundry foreman's salary, wages, pay, or whatever term it may have, is as variable when figured down to the measure of the gold standard as the price of coffee. Nothing can be told about the qualities of a foreman by looking at him, his teeth or his clothes. His age does not determine his knowledge. His apparel bears no relation to his worth.

What a foreman should receive for his services is one thing; what he thinks he ought to have is another. Broadly speaking, what a man thinks he is worth is in a certain measure a yardstick to gauge the extent of the faith which he has in himself. No man who is conscious of his own fitness is going to place the price of his services below par. The Knickerbocker Foundry Co., doing a business of general foundry work, recently sought to obtain a foreman, and the extracts of letters appended herewith are taken literally from applications received. The deviation from orthography to be seen in many of the letters are purposely left in their original state to show the extent of illiteracy prevailing among the average workmen. The editor of this paper once told the writer, who came sauntering into the office in a blue shirt and minus a vest, looking for a good job, that while clothes did not make the man, they had a great deal to do with the impression created. This is undoubtedly true, at least, from the number of jobs I have failed to get. I think it is true, and if I were at the present time addressing a body of men, who intended to make application for a position through the medium of a letter, and I hope I am reaching a few of them, I should say: "Gentlemen, learn to write a nice business-like letter." Your handwriting need not necessarily dazzle anybody by its contour. What you say and how you say it is more important. Some of the best business men produce a miserable chirography. But, above all things, learn to spell simple words correctly and leave large ones out, if you are not sure of your way. These things do not in any way affect your ability to conduct a foundry—but they have a great deal to do with creating a favorable impression.

I know it is hard work to secure an education. So it is to obtain anything else. Anything worth having does not come easy. Of course thousands of workingmen get all through their lives fairly well with but ten per cent of the knowledge they ought to have had and could have had, yet I believe the man with a good education, in addition to his inherent ability, stands a better show in the shuffle for places than the one who has ability alone.

ALTHOUGH HIS SPELLING IS BAD, HE CAN UNDERSTAND DRAWINGS.

"I am a practicle michanic have had considerable expereince as foreman and can handle any kind of work economicaly also have had fairly good success in the mixing of iron and understand drawings pritty well. Am forty five years of age and strong and active. As to salary I think a shop employing thirty molders should pay one hundred dollars per month to a steady and pushing man."

KEEN AND A STAR, AND IT IS ALL OFFERED FOR $3.50 PER DIEM.

"I am 32 years old and have had 17 years of the very best experience anyone could get in a foundry. I am a practiol man on all classes of jobing work and also a very keen hand at getting up good economical rigins for turning out work. I am the star man in the ———. I understand mixing and melting iron therrivly and can work men to the very best paying addvantiges. I have been assistant foreman in one of the largest foundries in ——— and I have run the ——— for 3 years. If I give good satisfaction I would want $3.50 per day."

RIGHT TO THE POINT.

"I am a practical molder, thoroughly familiar with general foundry work, cupola practice and handling of men to the best advantage. Am 30 years of age and would take the place for $20.00 per week. I can furnish first-class references as to ability and habits."

ANTI-FICTION AND IS GETTING $1,200.

"I am a thorough foundryman 25 years experience, 15 years as foreman. Well up in mixtures, shop economics with ability to handle men without friction and to overcome difficulties. Am now receiving $1200 in a shop working fifty molders."

GOT $125, BUT IS WILLING, PRESUMABLY, TO TAKE LESS.

"I am 44 years old have had 15 years experiance as foreman in jobing foundrys. I claime to be first class molder and also in handling men also in handling cupola can furnish the very best of Reference as to ability am strictly Temperate. I received 125 dollars Per Month here but would be willing to go on my merits."

MIGHT COME DOWN—DEPENDS ON RESPONSIBILITY.

"I am a practical molder by trade and on all lines of work for the past thirty years and have held a position as general foreman for the past eleven years with one firm. Am thoroughly conversant with the foundry and its work on either light or heavy castings, understand mixing and the management of the cupola, the core-room and all pertaining to general founding. As to salary, would say, it would depend largely on the kind of work and the responsibility to assume. My former salary has been fifteen hundred per year."

HE IS "NATUARLY TEMPERET."

"I understand the foundry bussiness in all its branches such as green sand, dry sand or loom work. Have been in charge of large and small foundrys. Age 51, would expect $3.00 to $3.50 per day. I am Natuarly a Temperet Man."

WANTS TO BETTER HIMSELF.

"I am 24 years of age and my experience has been such as would enable me to run your foundry to an advantage. In regards to salary my present position is worth $80.00 per month and my desire is to better myself."

TWENTY-FIVE YEARS' EXPERIENCE FOR $75.00.

"I have twenty five years experience in various shops throughout Penn & New Jersey and have been foreman of several shops and feel myself able to fill your position. My age is 40 years. Salary $75.00 per month for first six months with agreement to advance after that time."

HIGH WATER MARK $1,800.

"I am 40 years of age and have worked 24 years in the foundry. I have had practical experience in all classes of foundry work. Salary expected $1800 per year."

FIRST-CLASS.

"I am a first-class machinery molder. Age 43. Ten years in charge. Am steady sober. Understand handling men. The salary I want $4.00 per day."

YOUNG AND REASONABLE.

"I am 24 years of age and have had 8 years experience on all kinds of jobbing work. I calculate the wages for taking charge of the number you have stated is worth $75.00 per month.

TWENTY YEARS' EXPERIENCE.

"I have had 20 years experience as foreman mostly in machinery and jobbing. Am 48 years of age. As regards salary would expect $4.00 per day."

ALTHOUGH HE NEVER WORKED ON THE FLOOR, HE THINKS HE WOULD KNOW WHAT A MAN OUGHT TO DO.

"I believe i could fill the bill for you. i have 15 yrs expirrince at Genaral Jobbing and machine work but i have always worked at the bench still i certainly know what a days work upon the floor and i am not afraid to push men into doing their best. i am 31 years of age and a strictly sober man. i should consider $3.50 per day fair wages in a shop running 15 to 30 molders."

STRICTLY SOBER.

"I am 33 years old and had 12 years at Green and Dry sand and Bench work and can give you the best of reference in regards to pay 3.50 per day strictly sober."

TEMPERATE HABITS.

"Am familiar with dry and green sand. Heavy and light—matching and gateing and arranging for presses. Can layout and produce work economically also cupola practice. Am 44 years of age, temperate habits. Salary wanted $27.00 per week."

THOROUGHLY POSTED.

"I have had an extended experience of twenty years as foreman in making engine machinery tool and jobbing casting in loam dry and green sand mixing & melting iron & brass Core making and general foundry work Age 44 strictly sober Salary 25 per week a practical machanic thoroughly posted on the best practice in foundry can handle men & work to best advantage."

WHERE HUSTLE WAS THE ORDER OF THE DAY.

"I am 35 years old, straight sober and an everyday man. I consider that I am well

posted in modern foundry practice and can handle men successfully. I got my experience in shops where hustle was the order of the day I would consider $1200 per year as a salary."

MELTER AND COREMAKER.

"I am 35 years old have always worked in Jobbing shops am practical melter and coremaker and understand brass work. I would want $3.50 per day to start."

A BARGAIN AT $2.50.

"My age is 42 years. Was foreman 10 years and then the firm broke up. I never got less than $2.75 per day but if you can guarantee me a years work $2.50 per day."

$1,000 A YEAR.

"I am twent six years old. Have had eleven years experience in a foundry. Would be willing to come for $1000 the first year."

UP TO $2,000.

"I am 42 years of age a practical molder and coremaker. Can handle men to advantage. Sober, economical and steady. I can handle iron successfully and understand melting. I can figure out the weight of casting from the pattern. I will work for $2000 per year at first."

A HUSTLER AT DOUBLE A MOLDER'S PAY.

"My age is 40. I do not know the taste of liquor or beer. Can do well on brass, make estimates and give prices, have had full charge and know how to buy and sell. I have generally received double of a molders pay & I consider I am a hustler and know my business."

TWENTY A WEEK.

"Am 48 years old and temperate. Experienced in all classes of foundry work. I have a salary of $20.00 per week."

THREE A DAY.

"Age 36. Have had 15 years experience. Salary exspected $3.00 per day."

MODERN, UP-TO-DATE.

"I am 40 years old and have over 20 years good experience in the modern up to date foundry business, am used to all kinds of work, green, dry sand or loam, light or heavy castings, am used to handle men to advantage and turn out good castings at moderate cost, am also well posted in mixing and melting of any kind of iron or brass and always turn out first class work. About salary I think 20 dollars per week for a 3 months trial and 100 dollars per month afterwards."

WELL EDUCATED.

"I am 41 years of age, have had 27 years experience in foundry 16 of which in capacity of foreman supt and manager. I am well educated, thoroughly practical in all classes of work and cupola practice. Am thoroughly competent to figure contracts and solicit orders. Salary from $1500 to $2000."

JUST THE MAN WANTED.

"I am a regular jobbing molder, 40 years of age and believe I am just the man you want. Ambitious and strictly temperate. The salary I exspect would be $1000 for the first year."

EARNEST STUDY OF "TECHNALITICS."

"I am 34 years old and have acquired a good practical knowledge of high class molding in loam, green and dry sand. I have for many years givin the Technalitics of the trade my ernest study and am prepared to offer myself as one understanding the mixing and melting of metal and also the pressure of molten iron in mold and also the shrinkage and chrystallization of metals and I think with my knowledge of foundry appliances and equipments I could suit you both in proficiency and economy. I am strictly temperance and would undertake the work for 25 dollars a week."

* * *

Although extracts have here been quoted from but a small portion of the applications received for a common position as foreman in an unknown shop, yet I think I have shown sufficient to illustrate that there is no dearth of candidates for a foreman's office.

A case came under my notice a few years ago, where the foreman received $2.00 per day, while the molders got $2.25. The explanation offered was that this man would work for nothing, and work like blazes himself too, if he could only be foreman. I am beginning to think that there are others afflicted with the same mania.

Just why a man should offer to take charge of a general foundry for $2.50 per diem, when there are a great number of shops where the minimum rate of molders' wages is that figure, is something that puzzles me. If the man is a fair mechanic he can earn that sum on the floor and have no one's troubles but his own to brood over. If he does not

amount to anything as a workman, he certainly will not amount to much as a foreman. There is such a thing as offering ones services too cheaply. It creates a lack of confidence to place your labor in the market at fifty cents on the dollar. Most people have been deceived in "bargains" before, and the labor that is offered cheaply is open to the suspicion of being cheap.

I asked a foundryman the other day to what causes he attributed the oversupply of foundry foremen, possessed of good recommendations and evidently capable of filling the majority of places for which they apply. His reply was that foundrymen have adopted the reasonable and sensible way of choosing their foremen from among the timber to be found on their own premises, and that the man who expected to fill a responsible position must work his way up gradually instead of jumping from one firm to another. The foundrymen have learned that there is less experimenting with a man whose ability is known than there is with a stranger, to whom the work and methods are entirely foreign. Be this as it may, I know it is becoming more difficult to obtain a foremanship on the spur of the moment than formerly.

What becomes of our molders above fifty? As a man's experience and ability is largely a matter of growth, and the average man at fifty is considered to be in his prime, it is rather strange that out of the twenty-nine applications quoted but one has passed the half-century mark. Can it be that the trade does a man up by this time? Fifteen, or more than 50 per cent, were between the ages of 40 and 50; eight between 30 and 40, and four below 30. Basing the salary asked on a yearly compensation, one asks $750, four $900, one $960, two $1,000, six $1,050 or less, six $1,200, seven $1,500 or less, and but two above that figure, the average yearly salaray demanded ranging in the neighborhood of $1,180, which I am inclined to believe is slightly in excess of the actual amount paid throughout the country, although no foundry of any proportion and demanding the services of a good average man can call this sum excessive.

For years I have been wondering where the prohibitionists secured their votes. I have found it out by looking over these letters. I am something of a liar myself, and I don't believe a transgression of this kind is marked down against a man with indelible ink, especially when it is considered that the sin was committed while he was gunning for a job.

Bedding in.

Editor THE FOUNDRY:

I noticed an article in THE FOUNDRY of October on bedding in. It rather amused me when the writer argues what size hammer will smash a pattern up the easiest. I don't think it makes any difference to the pattern if it is broken up with a light or heavy hammer, so long as the molder did not have to pay for it. It reminds me of a young molder we hired one time. We gave him a light door pattern made of pine to make a casting from. He laid down his bottom-board, put his nowel on it, filled it with sand (riddled with the shovel, by the way) and was going to drive this poor sickly pattern into the sand with a sledge-hammer. The boss happened along about that time and asked him if he called that molding. He looked up surprised, and said that was the way they did it in Connecticut. Well, I was never in Connecticut, but I can hardly believe they would do anything like that there. It may be all right to mold a grate-bar in that way, but I think it is a shame to disgrace the art of molding by such a practice. If some of our old-time molders or sand artists were to wake up and find a man molding in that kind of way they would want to fight, or go back where they came from, disgusted. I look upon a good mold or a good casting as a piece of art; but this bull-headed way of driving a poor, innocent pattern into the sand with a sledge-hammer is a disgrace to the name of molder. I do not wish to leave the impression that I condemn bedding in when it is properly done, as sometimes it is absolutely necessary to bed in a piece in order to get a good casting. A man who understands his business will never use a hammer in bedding in only to take out the spring. He will either lay his pattern on a plain bed, or level blocks in the floor, and ram the sand up to his pattern. If he is molding a plain plate, to level up a bed is all right.

DOWN EASTER.

Notes on Metallurgy—Malleable Iron.

By E. C. WHEELER.

The theories and practices advanced for the manufacture of malleable iron are in a great measure applicable to immediate local

usage only, and where the experiment is tried to adopt same for general foundry working, we find ourselves in a mesh of contradictions.

This is due, no doubt, to the lack of literature, and insufficient data published upon the subject, and as this branch of the iron industry has expanded so rapidly in the last three years, it offers a great field for publication and discussion.

This paper is written with the hope that it will excite some comment, from which definite and reliable deductions may be made.

There is no great secret in handling iron after it has been poured, that being merely a matter of executive detail, but when castings show graphitic carbon when it should be combined in the original casting, or when after annealing, iron shows a perfect black fracture and yet is "short," or again iron is found which is exceedingly tough, with high percentage of elongation, and shows a decidedly "steely" fracture, we meet with some of the tantalizing features of an imperfect mixture.

The melter will advance plausible reasons for all these said defects, and will recover from them, yet in course of time the same is repeated. This experience is costly, in the matter of rejected material.

What effect upon the iron have the metalloids, silicon, carbon, sulphur, phosphorus and manganese?

Silicon, next to oxygen, occurs most in nature, and in the case of pig iron is the native or latent heat of the metal. It makes no difference how hot metal may be by the "induced" heat of the blast, if the same is not hot of itself by its own "native" heat, it will mis-run patterns. How often is iron hot, and will not hold its heat, and why? When carbon is thoroughly combined with the iron in test, the heat should be ready to tap; but the iron in a great many instances is not hot enough to pour, and is held in furnace until hot. What changes is the metal undergoing all this time as regards silicon?

Silicon and carbon work with each other in malleable iron as in open-hearth or Bessemer steels. The excess silicon is exerting itself to burn off, and combine carbon in both, and if, when carbon is in combination and metal is not hot enough to pour, the silicon is still burning off carbon, and metal is becoming "higher." The iron is losing its natural heat, the metal is becoming denser and castings commence to have a rough, mottled, pin-holed surface, due to the metal being "dead" quicker, and being poured harder. The life of the metal has been seriously affected.

Why are open-hearth steel castings poured into hard and dried moulds and not into green sand?

The elements silicon and carbon have been practically eliminated; there is no "life" in the metal of itself, nothing but "induced" heat; therefore, it cannot be handled in small quantities, and is poured under pressure, meeting on the face of the mold a hard, resisting surface.

Hold malleable iron in the furnace long enough, and the metal will become in same condition.

There should be a definite point established for correct amounts of each element, and this will suggest itself by thoughtful analysis.

If iron is not hot enough when carbon is in the combination, it would appear to be a lack of silicon, and when castings show graphitic carbon in the hard state, it would show an excess of silicon, which was not required to burn off excess carbon. The test in the latter case may have been misleading, as a quick immersion in water will combine the carbon.

Why will gray iron, which is not a "hot" metal, run much smaller work than its "hotter" rival, malleable? Because, the gray iron has native life for itself, is high in silicon and phosphorus, there being practically no molecular change in melting. Iron which is high in silicon will not anneal properly—there will be that "too wide white crystalline" edge, showing through the castings, and the product will be very stiff. How much carbon and silicon should there be in a malleable mixture?

This will depend entirely upon the local conditions of each foundry, and can only be touched upon in a general manner. For light work, keep the silicon up from 1.00 to 1.25; the loss in melting and annealing will average .50 to .60. The total carbon will run between 3.50 per cent. and 4.00 per cent. For heavy work, keep the silicon down. Why? It will be required to combine carbon much "higher" to obtain clear fracture of metal in the heaviest part of the casting. The metal will not have the "life" of the light work mixture, and will not run small

work. It's silicon (or its heat) is not there, and is not wanted, as the endeavor is being made to obtain a low silicon, low carbon product.

The more these metalloids are eliminated the closer we approach to steel, or that metal which has agitated the malleable business for some years—a direct metal without annealing. For heavy work, keep the silicon down to .75 and the total carbon from 3.00 to 3.25. If all the pig metal used is higher carbon, scrap the mixture with 10 per cent. wrought iron or malleable scrap.

Sulphur has always been considered very detrimental and injurious to good malleable; it's the metalloid which will destroy the value of a casting quicker than anything else. It produces "shortness."

Why will a perfectly annealed casting break under a few blows of the hammer, and not show any deflection to speak of? Why will a Bessemer ingot fall to pieces in the first passes through rolls? Sulphur asserts itself in its seeming propensity to dominate the metal, almost to the extent of separating the molecules. It destroys the clinging, close grain, leaving the same open. A mixture for either light or heavy work should not run over .03 or possibly .04, and would regard .05 as the danger limit. Sulphur will show itself in annealed castings, in peculiar ways. Take, for example, a long irregular shape, or a coupler. Often small and apparent shrinkage cracks will show along the barrel of coupler; it is not a casting shrinkage, and cannot be one. It's the action of sulphur, which of all the metalloids is hardest to get in thorough combination.

Phosphorus, in connection with silicon, produces fluidity; there cannot be high fluidity where there is a great absence of either. In the case of the mixture for light work, the silicon and phosphorus are kept purposely high. In the heavy work mixture, phosphorus is still high, but silicon is low; consequently, there is less life or fluidity there. Phosphorus enters readily into combination with the other metalloids.

I would keep mixtures for both light and heavy work between .15 and .20.

Manganese is the stumbling block for shrinkage, and upon which there is any amount of discussion at present. What is general practice places the amount in mixture for light work from .30 to .40; in heavy work from .40 to .60. One of the largest concerns in the country specify for pig metal 1.25 to 1.50. It looks like a strict adherence to a set formula, or an excess altogether. The first analyses seem a very general "middle of the road" practice. As all furnaces and foundries work differently, as regards the shrinkage of their metals, the amount of manganese must necessarily depend upon the amount of shrinkage allowed in the making of patterns. For mixtures carrying the amount of manganese before mentioned the shrinkage would average .225 per foot, hard iron. In preceding figures the amounts given are for the charging mixture, all initial percentages.

Who shall have charge of calculating mixtures and running furnaces?

In a great many malleable foundries where chemists are employed, their main work consists in checking up blast-furnace chemists, on pig metal purchased, but from personal experience it is found that the furnace chemists are very careful, and results do not vary enough to speak of. Why not let the chemists couple a little metallurgy with their knowledge, and let them have charge of the furnaces? They could locate and diagnose local troubles, and advance intelligent reasons for same. The foundry foreman would in this way be relieved of a great deal of pressure, and could devote his attention more to the economical production of castings.

Theory vs. Common Sense.

An amusing incident and most ludicrous decision of a foreman occurred down at R—— foundry the other day. A stove repair job came in for two No. 9 lids. An old one was sent along for a pattern, and it had two deep flanges on the bottom, and was quite thin between them. The molder put them up, face down, and cut a gate on the outer edge, poured with good iron, but the center did not run. He showed them to the foreman, who was tapping out—by the way, the foreman is a new one. He said, "Just let me theorize a little, and I will tell you what the trouble is." After due deliberation he came to this conclusion: "It is very evident that the outer edge cooling first drew the iron from the center; tomorrow, when you pour them, dig the sand from the center as quickly as possible, and pour on some water, thereby cooling the center first, and you will save the castings."

H. P. OLDS.

How to Become a Foundry Foreman.

By W. R.

In your September issue your "querist" appears to me to have rushed at this question with the first impulse of a youthful mind, desiring to be great without first placing his foot on the first rung of the ladder of progression.

I would like first of all kindly to advise him to seek to be a good journeyman and get as much information by practice and close observation in everything that pertains to foundry work as possible. There is a wide field for research in molding matters that was not available twenty-five or thirty years ago, and by utilizing this the aspirant of the kidney of my young friend would be greatly benefitted. I would also advise the reading of up to-date articles in THE FOUNDRY and other mechanical journals. No man can hope to be a thorough, intelligent molder who does not attend to mechanical construction. For instance, in "coring" a cylinder mold somewhat carelessly, what an amount of extra worry and labor the engineer has in facing up and adjusting such a valve face, etc.

I should not like to discourage one whose purpose in life seems to be fixed, but I would have him believe that although he were a foreman to-morrow he will not find it all a bed of roses, and for his own good, constitutionally and otherwise, he should consider himself in the right place as an ordinary journeyman or sub-foreman for the next ten years to come, at least.

I have seen in my day young men pitchforked into positions through influence, but a worse or less enviable position it would be difficult to imagine, as such are entirely at the mercy of the men, and can do little more than act in the capacity of a shop policeman. There may be exceptions to this rule, but they are few and far between and can only be where repeat work is concerned; but even in those shops a youthful foreman can never have the command over men commensurate with his position.

Allow me further to advise him to plod and work with determined energy, and seek to unravel the intricacies of molding in all its branches, both in theory and practice.

Take up such subjects as metallurgy, chemistry and mechanics, as in my opinion the only men that will shine in our trade in the near future are those who shall have at least a smattering of what I have indicated here. In other words, be not disappointed should you never be a "Shafter" or a "Kitchener" in so far as founding is concerned, but you will work the happier on account of your superior knowledge, and probably be a blessing to others around you.

Removing a Cupola From One Foundry to Another.

The accompanying illustration shows a 54-inch 40-feet cupola, with blocking and rollers under it. The Springfield Machine Tool Company, of Springfield, Ohio, recently built a new foundry and removed this cupola, with the 6-inch brick lining in it, from the old to the new foundry, a distance of nearly 200 feet, in an upright position, without cracking a brick, and at a cost in-

significant as compared to what it would have been had they torn out the lining before removal. As may be seen by reference to the illustration, a criss-cross blocking was arranged under the cupola, planks were laid on the ground, and leveled, and the cupola was moved on rollers from the old location to the new.

We find THE FOUNDRY very helpful, and just what every foundryman ought to have.

E. R. ALLEN.

THE FOUNDRY is a good investment for any foundryman, and is improving every year.

CHAS. ALAND.

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Trade Outlook.

By reference to the department in this journal under the head of "New Building and Enlargements," an idea may be gotten of the large movement in foundry expansion now in progress. No class of men are more alive to the importance of the factor of confidence in prospective trade conditions as a stimulator of industrial enterprise than the editorial fraternity. When confidence is wanting, business lags, and financial ruin follows. Knowing this, the writer upon current industrial topics is apt to enlarge upon the brighter aspects of the situation at all times, and to touch very lightly upon adverse conditions. Nobody doubts that the calamity howler sometimes tells the truth; but his doleful strains merely serve to aggravate the conditions that he, and everybody else deplores. There have been times when his advantages were so great that the wise were reduced to the recourse of denunciation, and to the magnifying of the few favorable circumstances to be gleaned from the business field as an offset to his pernicious influence. But the evidences of prosperity are just now so numerous in all portions of the country as scarcely to need a comment to emphasize them to the public.

Speaking of the iron industries in general, every report that comes to us is of the same gratifying character. Business correspondence is saturated with the spirit of hopefulness. Men say: "Wishing you a full share of the new prosperity"—or: "Trusting that you are sharing in the benefits of the business revival," etc. Such compliments of the day and season infallibly voice real conditions; for, they are invariably expressed, with a full confidence that they will be universally endorsed, as a matter of course. That our largest manufacturers believe that these happy conditions are going to stay with us for some time to come is fully evidenced by their immense outlay of money in extensive new buildings and equipment to meet the requirements of the expected increased demand. As a matter of fact there really ought to be no limit to general industrial production short of the utmost productive power of the aggregate forces of labor and capital, because, naturally, human want always outruns the productive power, and thus it is obvious that if the economies of affairs are properly balanced the demand for product must equal any possible supply. These economies are now assuming a normal inter-relation that tends in the right direction, and the momentum already developed will surely carry us forward to greater achievement than we have ever yet known.

Iron Making in the Cradle of the Race.

China, civilized before the birth of history in the balance of the world, occupies to-day the lowest stratum of civilization. Ancient Ethiopia produced iron centuries before Europe was known; centuries before the wild forester of the west emerged from the savage state, and all down the cycles of time the dark-skinned race has been manufacturing implements of iron. His processes today are just what they were when Hiram cast the brazen seas in the clay ground, for the temple at Jerusalem. He probably has not advanced so far as the metallurgist of Tyre had done so many thousands of years ago, for, though the Nubian works in iron, he does not make cast iron. His furnace is a sort of Catalan forge, a vessel having a refractory earth-lining, and holding two or three bushels of material. In this he lights a charcoal fire and then adds charcoal and iron ore, mixed; there are a couple of tuyeres near the bottom through which the air is forced

by rude buckskin bellows, four in number, operated by two men. They do not melt the iron, but simply reduce it to a soft mass, which, being mixed with charcoal and other foreign matter may be broken into small pieces after cooling. It is then charged into the furnace again and reheated, and removed while red hot, when the black Vulcan places it on a large flat stone and hammers it till the impurities are segregated out, leaving a broad, thin plate of iron, weighing about 18 pounds. This iron is said to be of a very superior quality. It is used by the natives in making bridle-bits, stirrups, gun-barrels, swords, plow-shares and tools of many kinds.

The fuel is wood, of the olive tree. The mines are not worked underground as we practice, but after our manner of operating stone quarries.

In contemplating the primitive stage of this industry in that far-away country, just south of Egypt, (what was Ethiopia when you and I were at school is now represented by Nubia, Sennar, Kordofan and Abyssinia), one can but wonder at the stupidity of a people who could almost melt iron for a period of four thousand years, yet who have never made an iron casting! The heat developed in the rude furnace is not sufficient to melt the iron, and it seems never to have occurred to their minds that a further step was possible.

A party of Nubian hunters, in the age of Rameses, dug a hole in the ferruginous bank, and, kindling a fire there, roasted their evening meal of venison. It was a damp, chill night, growing colder as the darkness gathered, so they piled on the fagots and the freshening wind blew up the fire that warmed the crouching forms of the half-naked savages, who slept or watched by turns. A few weeks later they camped at the same spot. Assaying to remove the ashes from their improvised hearth, they found—iron; the first they had ever seen. The intense heat had smelted the ore wall of their hearth. They built another fire in the same place, and, impatient to see the result, they pried out the glowing mass with long poles, and perceived that it could be bent and otherwise manipulated. This was the first open hearth iron, and the Ethiopian of to-day has taken one step farther in metallurgy, viz: he simply re-heats the mass before working it.

"Making Allowances for the Molder."

A writer in the American Machinist who signs himself "Ben Around," discusses the above topic in a spirit of liberality that is quite refreshing, coming from such a source. He is a machinist, and he says he has worked in shops all over the states, and that the same warlike feeling toward the molder exists everywhere. He deprecates this spirit of cynical criticism, and points out, in a very dispassionate style, the many shortcomings of the machinists themselves, setting them in array over against the molders' failings. The writer is evidently a thoughtful man, for he apprehends with precision the radical difference in the nature of the two trades that operates against the molder; for, as he says: "Considering all things does he (the molder) not deserve more credit than we machinists? I am sorry, but I believe that he does." He continues: "Does it ever occur to you that his work is hidden, while ours is before our eyes? He is always in the dark, for he never is certain of his work till the casting is finished. His mold once closed, he can only watch and wait; if he is successful, he receives no praise, but if the casting is faulty, some fellow in the machine shop can sneeringly point out the trouble." He adds: "A molder never attempts to instruct us." All this is true, and, "'tis pity too, 'tis true." The fact is, the molders' trade is of such a character that if he make a mistake, it is fatal; it cannot be corrected. In ramming, he may strike just one blow too near the pattern and a scab will result, and when we consider that he may have to strike several hundred blows in the making of the mold, it is not surprising that one of them may be amiss. Furthermore, he may make a half dozen perfect molds without a single error, and miss in some particular on the seventh, thus giving the enemy an opportunity to thrust out the tongue and say, Aha! aha!

When the machinist undertakes to turn down a shaft, he sets the calipers with great care, and measures with nicety to be sure that he is right; then he takes a cut that he is reasonably certain will have to be increased. After a few revolutions, he tries the work with the calipers, and probably finds that a little deeper cut is required. He runs the tool back and starts in with a little deeper cut, and perhaps it is just right; but it is probably not quite deep enough, upon trial; so he goes over the process once more, and now it's all O. K. Will any intelligent

machinist aver that such a "cut and try" process is open to the molder? Indeed, no. The tool may slip a little, or the drill may break, or an extra cut may have to be taken to correct inaccuracy; but none of these things show up in the finished work. Whereas, the mistakes of the molder are recorded on the casting with unfailing certainty. If the ways on the lathe, from long use, become worn so unevenly that perfect work cannot be done on it, the fact is recognized by the superintendent and the defect is corrected. But what about the foundry when a flask is become worn, burnt and generally unreliable? The molder calls the foreman's attention to it, but in nine cases out of ten he will be obliged to use it just the same; and when the casting exhibits a big cavity and a corresponding "hump," caused by a fall-out, he is told, in very emphatic language, that he ought to have put in more gaggers, or to have nailed a dutchman to the crossbar at that particular place. Now, as a matter of fact, there was a dutchman placed just there, but it was not nailed, and the bar was not deep enough to furnish sufficient bearing to hold it. Was it the molder's fault? Let us see; for, I assume that what we want, here, is to get at the truth, without fear or favor in any direction. The flask was old, and extremely doubtful; that is admitted. But the foreman thought that, under all the circumstances, it would be better to take the chances of getting a good casting from it. The molder knew, of course, that it was a question of economy, and he also knew that in order to economy, time was a prominent factor; in fact, at the bottom, the only factor. He placed 97 gaggers and 23 dutchmen in the cope, using his best judgment in their distribution; fourteen of the dutchmen were nailed to the bars; and the result proved that his judgment was accurate in 119 instances, but failed in the 120th. He took chances, it is true, but the very nature of the case compelled him to do so; it was expected that he should. Many of the chances resulted in his favor, but one of them failed. To have made everything quite secure would have involved the expenditure of time equal to the making of a new flask; and that was the very thing sought to be avoided. The casting was wanted in a hurry, and the foreman, judging from long and painful experience, knew that the superintendent would not listen to the making of a new flask for the piece. Now, who was really at fault for the loss of the casting? He who holds the molder responsible in a case of this kind thereby virtually affirms the molder to be a more capable man than himself.

This case merely illustrates what is going forward in many foundries all the time; and in view of this fact, it is no wonder that failures in the foundry are frequent.

Country Shops.

A correspondent writes that he notices an absence of discussion in THE FOUNDRY of the trade situation in its bearing on the country shops.

The country foundry, i. e., the foundry located in a village, or a small city, is, to the great metropolitan establishment, as the suburban store is to the down-town department concern. The business of the latter is very large, the economies of business are brought to the highest degree of perfection, the goods are fresh and reliable, you order what you want, and you get it at the lowest price. The things manufactured at an actual loss in a big factory, just to accommodate customers, and to hold the trade for the sake of the better things that may, and will come, though insignificant in amount to the latter would often more than keep a small foundry running the year round. Much of this work was no doubt offered to the small founder, but he must have a profit upon it if he touch it, and the price asked sent the customer to the city. Under the conditions that now exist and that will prevail in future the country shop must simply take what it can get, with a strong probability of the little growing less instead of greater with the advance of time. The tendency of the times is toward centralization, and the logical expectation is that it will continue so. The employer, merely as an employer, is rapidly going out of existence. Officers of corporations elected for the business of operating capital drawn from all sources, are fast superseding the old-time employers. The system is too young to afford a sufficient basis for intelligent prediction as to whether it will eventuate in the greatest good to the greatest number. But the system is here, and whatever may be the system to-morrow, it is certain that the old conditions will never be resumed. The country shop may continue to afford the owner a means of independent living, but, as a rule, it can do but little more.

Experimenting With Coke.

The Doylestown (Pa.) Republican, in a recent issue, says: "Vicenza Wetherill is trying the experiment of using coke in his foundry instead of coal. The first casting of metal melted by this fuel will be made today. Coke is much cheaper than coal and is used in many foundries throughout the country."

We had supposed that the experimental stage in the use of coke in the cupola was passed years ago, and that every foundryman had become acquainted with its superiority as compared with coal. Coke has been usd for melting in the cupola for, at least, 50 years past; though it did not enter largely into the business till about 15 years ago. Since then its use has become so general that it is now a very rare thing to hear anything else spoken of in this connection. The above quoted newspaper item shows, however, that there are people who still cling to Lehigh, or Anthracite coal for melting iron.

We were surprised the other day at the receipt of a letter requesting instruction as to the use of coke in the cupola. So, it would seem that there may be a good many foundrymen who are unacquainted with this fuel. Therefore, a few words here about its use may not be amiss.

Coke is superior to coal because it is cheaper, will melt the iron faster and hotter, and more iron can be melted at a heat. We will not attempt an invariable rule for its use, but will give a plan that will insure a successful start, and the intelligent foundryman can do the rest without help.

Let the bed of coke be such that, after all the kindling wood is burned out, and the coke well afire, the level top of bed will be 24 inches above the top of the tuyeres; then charge on 1,500 lbs. of iron; then, 80 lbs. coke and 1,000 lbs. iron, and so on to the end. This should insure a good heat, though the iron may be too hot. In that case, reduce the proportion of coke, a little each day, except on the bed, 'till results show O. K.

There is considerable variation in the quality of coke from some furnaces, and the melter must vary proportions to correspond; but this will be an easy matter when you get used to it.

Value of the Trade Journal.

The value of a thing is not inherent in the thing itself, but consists in the use that is made of it. The diamond would be absolutely valueless if men did not make use of it; likewise the trade journal is valuable only in so far as men appropriate its contents and apply the information gained to valuable ends.

We are led to these reflections by the fact that we frequently receive inquiries concerning questions that were thoroughly discussed years ago, and are well known to the trade in general. No doubt, "there is nothing new under the sun;" but to some individuals almost anything is new. A well-conducted trade journal, if read by the subscriber, will give information in the course of the year of value many times greater than the pittance that is paid for it. Consider for a moment the current discussion on malleable iron manufacture. A careful reading of all that is now being written on the topic would save, perhaps, thousands of dollars to a firm going into that business. Some fifteen years ago the writer was called upon to conduct a malleable iron business; and, had he known at that time what he has learned from reading a few articles of recent publication on the subject, it would have been worth at least a thousand dollars to his employers. At that time, malleable iron making was a mysterious process, well guarded by the successful makers, and there was practically no literature concerning it. We thought then that any brand of Lake Superior charcoal iron was adapted for the purpose, and we did not know that any kind of coke iron could be used. But we all know now that only certain kinds of iron, as to chemical content, should be used, and that coke irons are often quite as good as charcoal irons for the purpose.

Then, there is the question of packing, in the annealing process. It has been discussed more or less for a few years past, and he who reads only a part of what is written might be disastrously misled thereby. Writers have averred that neither iron scale, nor ore was essential for the purpose, but later writers insist that scale is much the best substance yet found, and that the oxidizing of the scale is essential in order to success.

Some years ago, it was thought to be necessary to fire the annealing furnaces for a period of eight days and nights, to complete the process; but it has been found that by using the right irons the time can be much shortened. We know, now, just what the

chemical content of the iron should be; and by chemical analysis, we avoid the costly errors that formerly were made. In short, the trade journals, and especially THE FOUNDRY, have cleared away the mystery that erewhile enveloped the art of iron founding, and he who cares to read, may know.

Method of Casting Test Bars for the A. F. A. Testing Committee.

Mr. Thomas D. West's paper on the above topic, read before the Pittsburg Foundrymen's Association, November 28, 1898, describes the very painstaking and successful process that he conducted in producing the 22 tons of test bars for the use of the Testing Committee appointed by the A. F. A. at its meeting in Cincinnati. The great need of uniformity in testing methods led the Association to inaugurate this work, and the value set upon it was great, as may be seen, when we consider the necessary cost of such a large undertaking.

It needed the skill and energy of just such a man as Mr. West to carry out the plans of the committee, and the vigor with which he has prosecuted the work proves that his selection was fortunate. To quote from the paper:

"We have fully eleven grades [of iron] which must be gone through before complete records of any value can be had to represent the physical qualities of cast iron. When it is stated that there are about 200 bars in each of these grades of iron, ranging from one-half to four inches, square and round, 15 inches long, half to be made in green sand and half in dry sand molds, the weight being nearly two tons for a single set, or 22 tons in all, the magnitude of the work which the American Foundrymen's Association has in hand, as outlined by Dr. Moldenke, will be recognized."

The article is elaborately illustrated, showing graphically the methods employed, both in molding and casting, and presenting the various shapes and dimensions of the test bars produced.

It is earnestly to be hoped that iron founders generally will take an active interest in this work, for it is being carried on in the general interests of the trade, and it means vastly more of value than can readily be estimated. Furthermore, it marks an important epoch in the art of iron founding that will reflect honor upon all who may be engaged in it.

In describing an improved ribbed flask in our November issue we inadvertently stated that flasks of this character were made only by the company whose flask was shown in the accompanying illustration. This it would seem was a mistake on our part, and we regret very much having unwittingly done one of the oldest and best known establishments in America an injustice thereby.

It would seem that the Estate of Oscar Barnett, with a business record of fifty-three years to their credit have been making this flask for a number of years and have adver-

tised it regularly in our pages. It is said that it was patented by J. Demerest, August 25, 1855, fully forty-three years ago and hence it would seem that the patent has expired. This house has been in business so long and is so well and favorably known by the foundry trade generally, especially the brass foundry interests, that their anxiety not to be overlooked in a matter of this sort is only natural.

They keep constantly on hand and can supply at short notice flasks of any shape or any size for brass foundry use as shown in their advertisement elsewhere.

"Radiant."

Vol. IV., No. 4, of the "6 x 9" leaflet published by the Radiant Publishing Company, Station B, Cincinnati, O., dated November, 1898, is devoted to the interests of the foundry business, but incidentally drops an occasional word about "Radiant Silver Lead;" gives a talk on Talc, and presents a long list of big and little things that the J. D. Smith Foundry Supply Co., of Cincinnati, is anxious to give away! (merely enclose stamp for postage), such as: locomotives, cranes, molding machines, blowers, dynamos, flasks, patterns, etc. etc. A paper by "Sam Due," is copied from THE FOUNDRY, which shows that the editor knows where to go for something good in foundry literature.

The publication is original, unique and interesting. You ought to read it. If you send them your address they will mail you a copy.

Making a Large Brass Casting.

By C. VICKERS.

Castings of brass, scaling over 1,000 pounds, are of sufficient rarity in most brass foundries to make an account of them interesting. I do not remember now just what this especial casting was for, nor does it matter. In shape it was like a large bass drum. Inside it was divided into four compartments by the partitions A A A A (Fig. 1). There was a two-inch opening in the upper

Fig. 1

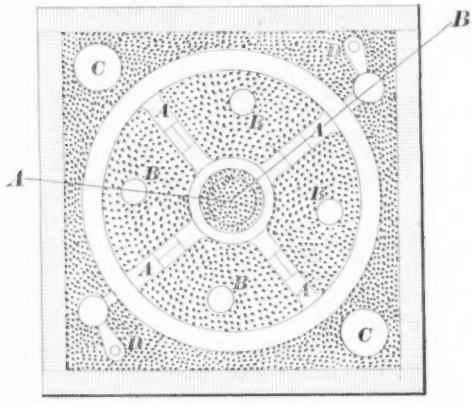
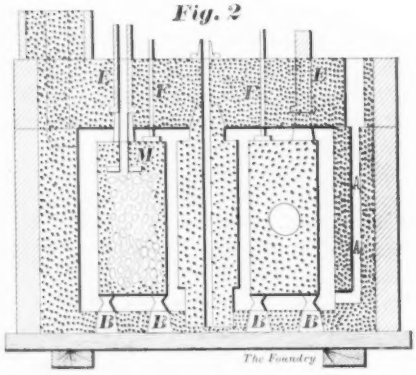


Fig. 2



Section through A-B. Fig. 1

side of casting, as shown at B (Fig. 1). This provided means for venting and extracting the core. The metal was run into the mold wholly from the bottom, and two runners were used, one of which is shown at A (Fig. 2). Two feeders were placed at C C (Fig. 1). When the mold was completed they were built up six inches above the cope.

The method of molding was briefly as follows: The pattern was placed on the followboard and the nowel adjusted thereon, the gate-pins A (Fig. 2) placed in position, and the sand rammed in firmly until level with the top of pattern, when the gate cores are bedded, on top of the gate-pins. The passage forming the gate in these cores was square in section, and the cores were filed so as to form a fillet on the casting, so that the gate could be broken off while hot without tearing the casting. After the gate cores were adjusted in place the position of the cores was carefully marked off, on the pattern, so that the anchor supports B (Fig. 2) could be placed in their proper position. The face of the support which touched the casting was coated with plumbago. The sand was then carefully filled in over the pattern, so as not to move the supports, and the whole rammed good and solid, the bottom board bedded on, taking care that the supports have a solid bearing thereon. The mold is then vented, rolled over and the parting made, the gate-riser and feeder-pins adjusted, and the cope fitted on and rammed up. A so-called "skim" gate was used. The metal is poured in at D (Fig. 1), where it drops to the joint of the mold, then turns at a right angle through a channel cut in the cope to the runner, which carries it to the bottom of the mold. It will be noticed that where the runner is carried up through the cope, it is enlarged to form a riser, which feeds the gate, making it good and solid. When ramming the cope, four bushings were rammed up on the core prints B. Their use was to anchor the core and dispense with the use of chaplets at this point, as shown at E (Fig. 2), so that it was only necessary to put in one chaplet on each core as shown at F. The cope being rammed, is lifted off and finished. The pattern is then vented all around by pushing a thick vent-wire perpendicularly down to the bottom board, keeping away two inches from the pattern. Then the pattern is drawn and the mold well and carefully cleaned and slicked, then dusted with flour, after which it may be polished with plumbago if so desired. The anchors or studs are placed on their plumbago'ed supports and pinned in place with a little copper wire to prevent shifting. Then the cores are placed and spaced so as to get an even thickness of metal all around. There are three anchors and studs to each core, so that it stands on a tripod. Each anchor should be of even height so that there will be no rocking, and the mold should have been leveled before the cope was rammed. The

core is held in place by one chaplet in the cope and the bushing on top of the core print. This bushing does not bear on the sand of the core, otherwise when the pressure came upon it the sand might crush and allow the core to float. A piece of perforated gaspipe of suitable size is built in with this core at this point; one end is flush with the top of the core print and the other, which is embedded in the body of the core, rests upon a large iron washer, as shown at M (Fig. 2). The core is vented by means of cinders, as shown. After the cores are in position the mold is closed, clamped and weighted, and the chaplets and bushings gently but firmly wedged against the upward pressure of the metal.

Three pots were used in pouring, as the furnaces would not take anything larger than a 250-pound pot. Two of these and one 70-pound were used. The man with the 70-pound was placed in such a position that he could pour into one of the large pots as it emptied without checking the stream. The sprue-head was kept full, the skim-gate permitting this, and after the mold was filled it was fed by repeatedly filling up the shrinker-heads, which, as before remarked, were carried up six inches above the rest of the mold. As the runners were no thicker than a broomstick, they solidified immediately after they were filled, so that the metal could not flow out when the heads were filled up.

A Recent Visit to England.

By S. GROVES, M. E.

III.

In describing the Eston hills, which dominate the Tees Valley near the Northern Sea, I referred to the immense layers of clay ironstone imbedded therein—17 feet thick, yielding 20,000 tons of ore per acre; but which, prior to the invention of the basic lining, were practically useless for Bessemer steel making, owing to the high percentage of phosphoric acid, averaging 3.87. Phosphorus, however, the bane of the steel maker, is the good angel of the pipe founder, since phosphide of iron is an excellent preventative of oxidation, and to prevent rust, is to conserve the strength and longevity of water and gaspipes. It is no wonder, therefore, that a flourishing pipe founding industry existed on the banks of the Tees twenty years before Thomas & Gilchrist experimented with their basic converter linings at the steel works near the adjacent hills.

Two of the three original pipe firms started out to manufacture as a sideshow only viz., Bolckow, Vaughan & Co. and Tees Side Iron Works, hence are practically out of the business; whilst the third, Cochrane, Grove & Co., Ormsby Iron Works, began from the first to manufacture pipe as a specialty, consequently are still doing a flourishing trade.

One can almost step off the pig beds of the Cochrane furnaces down into their pipe foundries, so near are they. A striking feature about these extensive works, covering 23 acres, is the excellent location, for the furnaces are bounded on the south by the North-eastern Railroad, and the foundries on the north by the river, with seven hours' ebb and five hours' flow. In fact, the shipping and freight facilities are simply perfect. Several large steamships were moored at the wharf, ready to carry their cargoes of pipe or pig iron across the ocean to the great seaboard cities of Europe; whilst the locomotives on the other side of the works were hauling their carloads to inland cities or to Liverpool, to transport to the colonies of Greater Britain. A perspective view of the foundry department from the top of the 90-foot furnaces is an interesting sight, for on the network of railways, which intersect the works everywhere, little "coffee-pot" locomotives are as busy as bees running in and out of shops with their loads.

There are some sixteen casting pits and nine cupolas in the five large pipe foundries and numerous jobbing shops scattered over the well laid out plant. The most interesting shop is about 120 feet square, with slate roof, supported on cast iron side columns and girders encased with corrugated sheet iron. Having been erected upwards of fifty years ago, and now giultless of paint, the general appearance of the oxidized and soot-covered structure is not very attractive to the eyes of one familiar with the newer American foundry buildings; but, if those iron-cased walls could speak, they doubtless would tell with pride of the thousands of large pipes made in "piping times of peace" in the four oval pits within, and now laid under the street pavements of nearly every important city in the old world and British colonies. Even Industry has its romance. A better planned foundry for its purpose could

hardly be imagined. Across the middle—east and west—is a railroad for delivery of supplies or taking out castings. At the north and south ends the cupolas are located, outside the building. On the diagonal lines approaching each corner is an oval pit, in which the pipe molds are skin dried and the castings poured. The system of ramming molds is peculiar, for it is done by hand in a separate circular pit, from which the three-part flasks are hoisted, swung around and deposited into the large drying pit, over a hole in the hot air chamber fixed in the bottom. The drying gas is forced down below from a small generating stove located on the edge of the pit above, at a pressure of say eight ounces. In the shop walls near each of the oval pits are two large lifting doors, opening into ovens, one for cores, the other for socket molds, both heated by old-fashioned coke fires. This primitive method, however, is being abandoned in other shops, and from what could be learned the improvement would soon reach this foundry also. Owing to the wide span of the roof, four columns stand on the floor (covered everywhere with plates) near the casting pits, and around each of these columns is built a 15-ton jib-crane of the Appleby type, originally operated by overhead shafting, but recently this noisy, geared, costly system has been torn out and hydraulic power substituted. Each of these cranes lifts the flasks from the ramming to the dyring pits; castings from the main pit to the delivery trucks on the central railway; cores from the ovens to the casting pit, and metal ladles from the cupola—an altogether admirable arrangement. Each of the ramming pits holds a separate hand-crane.

Here, as in all the pipe foundries in Britain, collapsing core barrels are in use for the larger pipes, in this respect differing from the general practice in American shops. They were not using hay rope or any fancy crumbling mixture, but a composition made of loam, burnt sand and horse manure, ground in pug mills. It is true, the first cost of these segmental collapsing barrels and expense of maintenance is an important item; but, on the other hand, the facility with which they can be withdrawn the moment the metal is set, cooled off and put in use again, the quickness with which the thin coating can be laid on and dried in the oven, is, in my opinion, an economy far in advance of the solid, inflexible, hay-rope-covered barrel system, in almost universal use on this continent; and from inspection of the interiors of pipes made by both methods, the palm for soundness and clearness, must, in my opinion, be awarded to the old world manufacturers. This may be a terrible heresy, but I am sure of my facts and hesitate not.

Another peculiarity in English practice is not so much the casting of sockets downwards, but the casting of an extra length of four or five inches at the spigot end, next the pouring gate, to insure solidity. This surplus head is subsequently cut off in the lathe. This custom prevails throughout the plant, since the government and continental buyers insist upon it in their specifications, and if American manufacturers are laying themselves out for competition in the markets of Europe, these conditions of manufacture will have to be complied with, which will involve a radical change in the operative methods now in vogue.

From this large pipe department I wandered into the medium pipe shop, which is about 200 feet long by 45 feet wide, and built of brick. In this foundry are four oval casting pits also, but in this instance they are all located down one side, the coremakers' stands and ovens being on the other. Down the center is a tramway, upon which the metal ladles on carriages are hauled to the respective pits from the cupola situated on the core oven side, midway between the ends of the shop. Here are made pipes ranging from 6″ to 12″. In the European practice, pipes 12″ diameter and upwards are made in 12′0″ lengths; below 12″, in 9 feet lengths. Collapsing barrels are used. At each pit are located two cranes, as in the foundry described, the larger being operated by underground shafting, the smaller (for ramming pit) by hand. Between the oval pits are openings in the wall, through which the red-hot pipes are rolled about 20 yards on to a gauntry at right angles, running the whole length of the building and terminating at the hydraulic testing house. The cupolas are driven with Root's Positive Pressure blowers, the vertical metal lift operated by hydraulic power, and core ovens and pipe molds heated and dried by gas from producers.

The precision and systematic operations to be observed in this foundry are worth going a long way to see. One thing impressed me

very forcibly, and it was the fact that the men did not work anything like so fast and hard as they do in this country, which indicates that even were the conditions in rivalry equal as regards appliances and facilities, the average American would outstrip the British manufacturer in the important matter of output, because the men do more work in a given time, which goes a good way towards counterbalancing the higher wages paid to American workmen, for $12.50 per week is deemed a high wage for the "straightner," or man in charge of the English pit gang.

My next view was inside the smaller pipe shop, which was named by the men "the slaughter house." It is about 84x45 feet, and was originally a jobbing shop. In it are now four casting pits for pipes 3 to 4 inches in diameter. Talk about a beehive! How the men avoid accidents in this cribbed, cabbined and confined shop is simply a marvel. The jib-cranes are operated by hydraulic power. Solid core barrels are used, but not a particle of hay rope could be seen. I witnessed pipes cast, and after a few minutes saw the top of the projecting core barrel struck one or two blows with a heavy wooden mallet, and then hoisted out with the greatest ease, looking as clean as if it had been scraped by hand. A special coating composition is used, consisting of sawdust, loam, etc., invented by the pipe foundry foreman, hay rope being abandoned altogether. It was claimed that great economy had resulted.

In the August (1897) number of THE FOUNDRY a discovery was announced as ranking with Bessemer and Harvey steel processes. The article was headed "Fletcher's Process," described as consisting of sawdust, hydrated starch and dirt, applied to core barrels by a specially designed machine, with a number of rollers, cog-wheels, etc., and a saving of 80 per cent was claimed in the making of a 6-inch core. No doubt this remarkable process, so ably described by Mr. S. S. Knight, is all that is specified; but yonder, in conservative Old England, I came across a crumbling mixture for coating solid core barrels, which was put on to a 4-inch core bar in a green state, without using a specially geared roller machine or other complicated apparatus, but which was apparently perfectly adapted for its purpose, and has been in successful use for years! In my presence a solid core barrel was hoisted on to a pair of cast iron stands, a laborer fixed a cranked handle on the spindle end and commenced turning the same;- then the core maker dug his hands into a trough within easy reach, lifted out a batch of the moist, loamy mixture on to the forming board, spread it out upon the revolving barrel, until the required thickness was attained. The green core was straightway carried into the oven for drying, ready for its final coating of charcoal blacking. "Flavell's process" seemed to me a very simple, inexpensive and effective system, and were I in the pipe founding business, should want to use it.

But, with the best of intentions to avoid prejudice and bias, it must be admitted that even if their method of making larger pipes is equal to anything in the States, the Britisher is undoubtedly behind in the expeditious manufacture of smaller pipes; for they are still making one in a flask, whereas in the R. D. Wood Co.'s foundries and others here, two and even three are made in a flask, with an additional advantage in tonnage, since the pipes are made in 12'-0" instead of 9'-0" lengths. In this respect America is manifestly ahead; and as the city corporations of the old world buy proportionately a greater number of smaller than they do larger bore pipes, it is not to be wondered at that the American founders are entering the "open door" of Great Britain in keen competition for the trade in her home markets, in spite of higher wages and freight across the Atlantic.

Space forbids any detailed description of the other large shops, or of the numerous pipe banks, where an immense number of small-bore pipes are made in green sand molds and dry sand cores; nor have I time to dwell on the jobbing shops, where the specials and irregular pipes are made, except to remark that as regards equipment they are behind the best of our recently built shops, such as the Walker, Westinghouse, Cramp, etc., the general use of cast iron flasks being an exception. Electric or compressed air traveling cranes were conspicuous by their absence; stripping plate, or vibratory drawback machines for molding small-sized, standard tees, crosses, elbows, collars, etc., there were none; green sand cores seem not to have been heard of; power sand sifters were not employed; the metal ladles of even

considerbale capacity were minus the quick, reversible trundle gear operating mechanism, now popular over here; and were it not for the fact that the men can handle the primitive appliances and tools almost with their eyes shut—for many of the molders have been working on the same floor for thirty or forty years—good old firms like this one would not be in it in the "struggle for existence;" and since the "survival of the fittest" is the order of nature, they and many another firm famous in the days gone by, will have to bestir themselves, yes, even faster than they are doing, to adapt themselves to the new conditions of international industry, or "Mene, Mene, Tekel, Upharsin!" will soon be written on their gates.

It is of course easy, with our modern light, to criticise buildings and appliances designed and built 50 years ago; and it is very easy for those who have not to pay for demolition and tearing up by the roots to suggest improvements which would involve the shutting down of busy plants, the danger of which the owners know, the danger of losing in the meantime their hard-won trade. Hence they tell you that, even though they perceive the necessity of radical alterations in their plant and equipment, it has to be done as opportunity occurs.

So far these notes have been confined to pipe making in the north of England, but in the midlands there are three large plants also; one I could describe, viz., the Stanton Iron Works, in Derbyshire, who have one shop, equal if not superior to anything in the Cochrane works in the north. Circular pits, with central hydraulic cranes, combining the operations of ramming, drying, casting and stripping. The ovens and pipe molds are heated and dried by producer gas. The larger pipes are cast direct from the blast furnace, and they get their supplies of ore and coal from their own mines. Then there is the extensive Staveley Company's plant, and the recently built Sheepbridge Iron Co.'s new works, with the best English equipment and self-contained as regards supplies. With these natural advantages and cheap labor, one would think that they have only to adopt more modern labor-saving appliances, such as Cramp's pneumatic rammer, Chicago pneumatic chipping hammers for cleaning pipes, Tabor vibratory molding machines for specials, and other American machinery of tested economy, to make it next to impossible for even our best manufacturers to compete in the home markets of Great Britain.

The morning I visited the Ormesby works, Mr. Henry Cochrane, the general manager, and originator of the plant, had before him the startling news of the invasion of Britain by American pipe foundries, notably the R. D. Wood Co., of Philadelphia, who had just opened an office in London, and one could see amazement at this unparalleled audacity. But, just as the British lion has recently taught Russia, Germany and France that it is the unexpected which is adways happening, so could be seen on the face of that veteran pipe founder, in the Ironopolis of England, the determination to put on his sword and buckler. His firm have got the land—an ideal location; got the men—the superintent (Mr. Richard Pratt) is a well-trained engineer and pupil of Lord Armstrong inventor of the Armstrong gun; oval pipe joint, and accumulator for hydraulics; and what is more, got the money, too! And probably a very few years will witness a complete revolution in that plant, enabling them to make pipe so cheap, and of such quality and finish, as to put competition out of sight. In taking this view of the possibilities among our "kin beyond the sea," I am reminded of Mr. Andrew Carnegie's warning in that exceedingly interesting book of his entitled "An American Four-in-Hand in Britain" (page 236): "Let Uncle Sam look out. If he thinks John Bull will remain behind in the industrial or the political race either, I do not, and I believe when he sets to work in earnest he cannot be beaten."

The Buffalo Blower.

A French manufacturing concern writes as follows to the Buffalo Forge Co., Buffalo, N. Y.: "We are very glad to inform you that we have our new foundry in operation since last week. We have already cast twice and your blower gives us very good satisfaction. Pontbriand & Frere, Limitee.

What They Say About the Foundry.

I would not be without THE FOUNDRY for anything.

T. L. PEVERLY.

Pawtucket, December 2, '98.

I am very much pleased with THE FOUNDRY—would not be without it.

WM. F. CORKEM.

The Record of Seth Boyden's Experiments on Malleable Cast Iron.*

By G. C. DAVIS.

NOTE.—Boyden's original manuscript, which is here published for the first time, contains many obscure passages. The papers had become disarranged and stained and the edges had crumbled away so a few lines are missing. There are many interlineations and foot notes. Where the author's meaning is clear these have been inserted in their proper place. In the case of obscure sentences, owing to the condensed form in which the notes are written, it was impracticable to decide what meaning the author intended to convey, and so they have been left as they stand. The marginal diagrams in experiments No. 1 to No. 9 are supposed to refer to the shape of the castings and are possibly cross sections of them. It is apparent that he made use of these as a method of keeping track of the different mixtures, and in a few cases, as in experiment No. 6, we can trace a relation between the shape of the diagram and the proportion of iron used. The figures following the word "suppose" in the various entries in the year 1830 are possibly an estimate of annealing furnace charges stated in hundredweights, quarters and pounds. Many abbreviations are used, such as L. for Lime, A. for Ashes, P. A. for Pearlash, and often the initial letter to designate the various kinds of iron, though the latter is sufficiently clear from the context. G. C. DAVIS.

EXPERIMENT NO. 1.

Soft or Sterling pig, dark gray, a little white at point, very little altered except whiter on outside.

Hard Sterling, fine white crystallized, tough on outside, middle softer and brittle.

One-half hard, one-half soft Sterling, fine white crystallized, needle ditto, tough on outside, middle softer and brittle.

One-fourth hard, three-fourths soft Sterling, less needles, tough and superior, good.

One-third hard, two-thirds soft Sterling, most needles tough, outside bent some. Done three days in one-half L., one-half A. A. had been exposed to the atmosphere nine months and acquired oxygen, which scaled the surfaces. Perhaps an error, as all others scaled. Pieces that were in the iron disappeared, heated with charcoal.

*This is a continuation from our last issue of a paper read before the October meeting of the Philadelphia Foundrymen's Association.

EXPERIMENT NO. 2.

One-fouth hard, three-fourths soft, dark sparkling crystals, tough and good, a little porous and blackish in middle.

Soft pig, nine-tenths wrought, gray bright sparkling, good enough.

Soft pig, second melt, bright sparkling, needles good, little porous in middle.

One-third Sprue, two-thirds soft pig, bright sparkling gray; moderately soft, tough, black, porous.

One-half Sprue, one half soft P., bright gray; moderately soft, tough, black, porous.

One-fourth soft pig added, bright gray; less tough, black, porous.

Sprues of above bright gray; less tough, black, porous.

One-third hard pig, fine white needles, tough outside, bend considerable; done three and one-half days in L. strong with P. A., and a higher heat supposed to cause the porous appearance, a slight scale or stain in the white packing, the whole tolerably good, but rather black and imperfect inside, tough enough on outside; heated with charcoal.

EXPERIMENT NO. 3.

One-fourth hard, three-fourths Sterling pig, melted with Lehigh; middling good.

One-fourth hard, three-fourths soft Sprue, afford much plumbago melted with Lehigh; some mistake, one of the two melted in charcoal; little altered except the point.

One-fourth hard, three-fourths Sprue, which yielded much plumbago melted with charcoal, little altered; done three days in ashes, heated with Lehigh, very badly scaled; some pieces of some of the former sort were put in, most of which was much blacker inside and not half as good. It appeared the sulphur had penetrated all through; pieces of charcoal in casting disappeared and pieces of Lehigh remained; iron much blacker around such places.

EXPERIMENT NO. 4.

Hard pig, thick, tough skin, middle but little altered.

One-half hard, one-half S., tough skin, middle but little altered.

One-third H., two-thirds S., tough skin, middle some tougher, a little grayer or stronger appearance; done three days in L.; scales considerable, none very good.

EXPERIMENT NO. 5.

A batch done three and one-half days in L. and A., well packed, at a little more than cherry heat, or about hot enough to harden steel, treated in a wood fire, partly covered with ashes, and careful attendance; no alteration in the middle, a little scale and very thin, tough skin; a piece which had been done tolerably well before rendered dark in the middle. The heat had evidently not been strong enough; a number of pieces were of the same sort as had proved good at other trials; every sort was exactly the same.

EXPERIMENT NO. 6.

One-fourteenth W., six-fourenths Sterling; fine, strong, superior, good before anything I have ever seen.

One-fourteenth W., six-four teenths Sterling; near the same as above.

One-twenty-eighth W., six pieces S.; near the same as above; a little darker.

Sprues of above near the same as above; the above bent to less than one-half inch circles.

A piece one-tenth inch thick, Sterling, second melt; good.

One-fourth hard, three-fourths Sterling, melted with Lehigh; middling good.

One-seventh W., six-fourteenths Delaware, white; very much crystallized and brittle as glass.

One-twenty-eighth, six-twenty-eighths Delaware; very much crystallized and brittle as glass.

Three-fourths wrought, one-fourth D., bend some, full of air holes; too stubborn; hardly done in thick part.

One-fourth hard, three-fourths soft Sprue, yield much black lead, melted with charcoal; bend some, crystallize some.

One-fourth hard, three-fourths soft Sprue, melted with Lehigh; middling good.

One-third H., two-thirds Sterling, done a second time, through; first time a tough skin.

Done a second time, one-half through, soft, three or four different color rings, bend some, wrought iron melted with charcoal, dust hard, rendered tough and malleable; some fine crystals but good; pieces of iron from the foundry apparently done through, brittle as before. The above had been done three and one-half days at a low heat and not altered. Some pieces were put in that had never been put in before equally well done. This lot was baked three days in L. and A., strengthened strong with P. A., near a white heat. The packing had not, however, melted. A piece of thin sheet iron was eaten all up, not all gone, some of it found nearly consumed. The surface of all appeared to be eaten, but no scale. The packing black around the iron and quite strong when taken out. The outside of the vessel scaled very much, the clay sides of the furnace burnt about as hard as a brick. Furnace had a draft of 1 foot filled with charcoal. It was covered to check it one-half of the time. Sterling all good. Delaware all crystallized and brittler than before, but done through and malleable, one-seventh white and six-sevenths Sterling the best. A piece of English M. iron was in, but no important alterations.

EXPERIMENT NO. 7.

Bend but very little, at point malleable and coarse in thick part; hardened like good steel.

Much as above, but no tough skin as in other cases.

Brittle and not malleable; many other pieces were brittle. The above done three days in sand, one-eighth potash, at a heat that would near or quite melt brass; the packing melted to a stone. The sand and P. A. had so strong affinity for each other that the alkali did not operate on the iron, and none of it would answer, though very much difference in it, some more brittle than others. The sand packing only part filled the vessel—L. and A. packing filled the remainder, which was not melted where it joined the melted sand, nor even stuck together; the vessel worn out; it was about one-quarter inch thick and stood seven heats. One heat was not hot enough and one with Lehigh, which wasted it very much.

EXPERIMENT NO. 8.

Done three days in a new vessel which contained three smaller new ones with different packing and a difference in the packing outside of the small vessels. The heat strong, sometimes enough to melt silver, generally not quite so hot as No. 7, though in the same situation, and near it the packing not at all melted. The clear ashes stuck together most in the large vessel and outside the smaller ones packed with one-half A., one-half L.

Hard pig, melted in coal dust from the air; but little altered.

Soft Sprue, second melting, piece of rusty wrought iron laid on top, which made it ferment or change to wrought iron and thrown off scoria; but little altered.

One-eighth wrought, seven-eighths Delaware, heated and pounded to dust; some grayer.

One-fourth hard, three-fourths soft Sprue, M. Lehigh; quite gray.

One-fourth hard, three-fourths soft Sprue, quite gray; none of the above bend at all or good for anything.

In small vessel; packing, clean ashes; little or no scale outside; near black, bend some, inside gray.

In second small vessel, clean lime; the same as above, or first small vessel; in third small vessel L. A. strengthened with P. A.

Surface clean and white; near as above in other respects.

Surface clean and white; bend about the same as others; much whiter inside, slightly crystallized on outside; no tough skin as in other cases and not as much affected as other piece. The packing very strong when taken out, the clean A. and little or no strength; L. appeared as usual.

Question whether the new vessel and small ones make too much iron for packing or the quality of the packing or the heat being raised sudden to its hight, or too high, or from what reason they were not as good as before is to be found out, and whether the gases found their way from one packing to the other is unknown, or at too strong a heat it has the same attraction as when melted; the next experiment to be tried on that question.

EXPERIMENT NO. 9.

Done three days with two small vessels inside, one with clean L. and one with clear A., the results both the same; in the large vessel outside of small ones one-half L., one-half A., strengthened. Much better on pieces of the same castings; that in clean L. and clean A. bend to a 5-inch circle, and that strengthened bend to a 3-inch circle.

Sterling less than one-eighth wrought by its not all melting; bent, but too black and porous.

Point bend, but large part too brittle.

Hard pig melted with glass, not done through glass; no effect, bend some.

Delaware one-eighth W., pounded fine with glass, brittle as usual.

A piece of hard pig that was in L. A. S. bent to one-half circle.

The Delaware in all cases crystallizes. Sterling one-eighth W. and part Sprues of the same the best. One-half L., one-half A. strengthened has done the best. Whether two-thirds L. and one-third A. strengthened would be better or whether strengthening is necessary, to be tried. It appears at a low heat it scales; at a little above the heat to harden it does not scale. The packing grows black around the iron, the iron grows white; if any scale was on it, it goes off; grows some. If a greater heat the iron has the same attraction for its impurities as when melted. Hard pig at a low heat will have a tough skin, and at a strong heat it strikes through and is liable to crystallize. Hard pig melted in coal dust from the air received no change, but in scoria and coal dust becomes soft gray iron; no doubt but gray cast iron yet contains a part of it—or natural principle; a piece of Sterling without W. in a fine soft gray state done eight times remains gray and unmalleable.

EXPERIMENT NO. 10.

No. 10 contains iron from No. 9 of the noted iron works in different places packed one-third A., two-thirds L., strengthened one-eleventh of its weight, which was apparently good, but unfortunately the vessel burnt through, and the iron was near half consumed in oxide. A small vessel inside contained piece of Sterling one-eighth wrought, which proved best, and packed with one-half lime and one-half ashes was evidently better than lime or ashes alone, but not as good as a similar piece in the strengthened. A long piece was put in, extending from top to hottest part, which was at a heat sufficient to melt silver. The heat was not raised so high the first 12 hours. The lower end was good except the scale 2 inches above. It was harder 3 inches, not quite done through 4 inches. A thick skin 5 inches, a thin one 6 inches only scaled, and crystallized appearance gone.

Peru very good and excellent grain.

Bennington, Vt., very good and bent to a 2-inch circle.

Ætna, Egg Harbor, near the same.

R. B. & Co., Salisbury, white brittle.

H. C. & Co., Salisbury, white brittle.

Washington, white brittle or a little whiter.

Scotch, white brittle or darker.

Weymouth, Egg Harbor, brittle.

The above were all one-eighth wrought, which is perhaps the best proportion. None of the above was black porous, but appeared like wrought iron, wasted away in a slow fire. Whether slow commencement of heat or from what cause there was no black porous remains to be decided.

EXPERIMENT NO. 11.

Done three days in one-third A., two-thirds L., strengthened one-eleventh, heat slow 12 hours, then kept at a heat that would melt silver as near as could be, which has succeeded the best. A small vessel with packing that had been once used equally good and by far cleaner and whiter surface on the iron. The iron that was tough when broken was rather too dark colored. That which was brittle was white and more steel like. The packing was quite strong and smelt like the remains of burnt gunpowder; some pieces of iron tasted stronger than others. Sterling the best, perhaps; more liable to be black porous. Peru near as tough and best looking when broken. Bennington, Vt., not much inferior to the above, outside lighter, inside darker.

Ætna, Egg Harbor, bent to a 4-inch circle; very black grain.

H. C. & Co., Salisbury, bent to a 6-inch circle; white minute crystals.

H. B. & Co., Salisbury, white brittle crystals on outside; coarser.

Weymouth, Egg Harbor, brittle, sparkling.

Scotch, brittle, dark, steel like.

Washington, brittle.

Sheldon, Delaware, brittle, crystallize like zinc, large and brilliant.

EXPERIMENT NO. 12.

Ætna, Egg Harbor, melted a second time with more wrought iron, as the above did not take up all that was intended. The black grain disappeared and would rank the third. Carthage as good as the next above. C. S. Salisbury the same as above. The above was done two and one-half days in packing as No. 11, with a sudden heat as hot as the draft would make it, and con-

tinued the same throughout sufficient to melt brass. Pieces were put in that had been in 12 hours in a low heat; near the same as others which were put in fresh, perhaps a little better; in a small vessel one-third sand was added; equally good and no black pores in any; the points were more crystallized and not as tough as where it was near one-quarter inch thick. A piece 10 long reached from top to bottom, scaled two-thirds length, most scale one-third from top, very little altered at top, one-fourth length down began to have a skin, two-fourths thick skin, and two-thirds down done through. Pieces of Salisbury and Scotch which were done in No. 11 and No. 12 remained white and brittle. This was as hot as any number and near as good. A little wrought and melting again will remove a dark grain, but the cause of black pores is unknown, but evident that sulphur is injurious.

July 4, 1826.—Experiment in foundry. Sterling the toughest, but very dark. Sterling and one-half Peru, near as above, perhaps the best work. Sterling, Peru and Carthage, less tough and dark. Peru strong, bright and not as tough as Sterling, but good. Carthage brittle and bright, not good. Sprues and Sterling, dark and good. Sprues and Carthage, bright, some dark, rather brittle. Sprues generally bright, some dark, rather brittle. One part Sterling, two parts Peru may be the best. Several circumstances strengthen the idea that it may be refined too much, such as Sprues being brighter and brittle; a piece of different thickness, thick part tough, thin part which ran furthest much brittler.

August 4, 1826.—Forty pounds Sprue and 60 pounds pig dark colored in part, ⅜ inch thick, bakes with less heat; soft, tender and bend well. Fifty pounds Sprue, 50 pounds pig white, when baked a perfect resemblance of some English of the same size. Sixty pounds Sprue, 40 pounds pig white, very hard, very little affected, not sufficiently done. By baking at the same heat as the above only a tough skin; work of the same castings which lay in a stronger heat perfectly done. It is evident it must be refined to a white and very probably it can be carried too far. In a piece one inch thick it may be a little darkish. A heat sufficient to melt silver is absolutely necessary and much hotter is better, which is against the eighth experiment or heat. The above was done three days, the bottom hot enough but top not so hot as to affect hard pieces; those a little dark done soft, bent some. Pig may be refined at the first heat so as to anneal very reluctantly.

August 20, 1826.—Heated three and one-half days, part hot enough; pieces, scanty refined, baked much the easiest, which is a further proof that it can be refined too much. A piece that had been in the former heat and not but little affected, being much refined, was done through, and piece adjoining it exactly as that was before, done a second time, the piece was bright outside and dark inside. The part where it was broken after the first baking bright as the outside, as cast. A variety of sorts in a box filled with sand and packed in the oven done exactly as that in the strong packing.

August 25, 1826.—Pieces in sand submitted to a strong heat, say something more than to melt brass, for 18 hours; pieces well refined turned gray as others that were not refined. White pieces packed in lime strengthened submitted to the same heat, some brighter, both appeared to be done through, and both alike brittle; whether the heat was too strong or not continued long enough is the question.

August 26, 1826.—Pieces packed in sand and placed in a silver heat 18 hours; those that were well or much refined but little altered, those a little gray made grayer; none bend. Treated the same over again for 18 hours some pieces began to bend and some were very good, while others not refined so much were gray. The well refined piece that turned gray in the strong heat was in both last times and is gray cast iron yet, which is a circumstance against a very strong heat. Whether pieces of that casting can be made good will be known when the general heat is taken out. These experiments were tried during the baking. I think it is evident that a strong heat at first will render it grayer or black porous.

August 27, 1826.—Did not come tough, though done through. The batch was overheated, the bottom run together and much of the work melted in pieces. Crystallized very bad. Some of the work on top was middling good, some castings were not good and were those refined too much or made from a large portion of Sprew. I think Sterling will bear the most melting.

September 10, 1826.—Pieces of different castings packed—placed in the oven at a silver heat 24 hours; some pieces bent some, but appeared not done; others were less done and broke short. Packed again in fire sand 24 hours more; when taken out scale cleaned off, cooled; some appeared to be done much more, but rendered much brittler; bent none. Packed again, heated one hour and two or three hours in cooling; appearance, some strong, bend but little. Packed again and cooled off in the oven, the heat being below the point and the fire kept up six hours. Some of the pieces were tough, gray and very good, others less gray and good, and some white and appeared not to be done, and bent some. A question whether it ought not to be heated so hot or whether it ought to be a long time in cooling. This oven heated and bad crystallized, thrown into the furnace after casting, which became red hot, came to a steel-like appearance, then packed in sand and submitted to the heat 24 hours; came out superior, tough, and a little gray in some places.

September 13, 1826.—The heat kept up three days; in one tub was 100 pounds and in fire sand and in another was about 400 pounds, packed in lime, strengthened; if any choice the sand was the best, but no difference. The work consisted principally of four castings, and no difference appeared in casting. But one heat was not done or scarcely affected. One casting was one-half Sprue, others less Sprue; the one-half Sprue was brightest when done, but all was black porous and all cast of Sterling.

Twenty hours in raising the heat, and the last 20 hours the heat was not kept up to the melting of silver; probably the heat had been too high, or from what cause it was black porous was unknown or the cause of the bad heat.

October 3, 1826.—Baked three and one-half days in sand, to the point only one-fourth of the time. Sterling bend some, but too gray to tin well. Two-thirds Sterling, one-third Peru, better, but gray. One-third Sterling, one-third Peru and one-third Sprue, gray, good. One-half Sterling, one-half Bennington and usual quantity of Sprue, some gray when cast, which shows the Bennington to bear more Sprue than Sterling. One-fourth Bennington, one-fourth Sterling, one-half Sprue, black porous, brittle, bad. One-third B., one-third P., one-third Sprue, ditto and all white when cast; a good baking; overmuch scoria is injurious, as appears.

October 20, 1826.—Baked three days in sand, heated very gradual, as a new earthen pot surrounded the iron one; heat up to the degree one-third of the time; work generally well baked. Some places were black porous and some articles of an unknown casting were burnt or cracked in every direction and coarse and brittle as a brick. It had marks of scoria. A piece of an article part done in sand and part of the same article in oxide of iron, and both equally tough and same appearance inside. The outside of the piece done in oxide was white about one-thirtieth of an inch deep and the middle blue or lead color. The best piece I have ever seen made in a large way was pale blue in the middle, say about one-third of the substance, the outer part white, without crystals, and breaks like tin; it appears to have been Sterling and had scaled some in baking—perhaps a part was Peru. A piece coated with glazing and hung in the open oven 36 hours became tough in part one-tenth of an inch, and ¾ inch thick appeared a perfect gray cast iron. Further examination proved beyond a doubt that if iron be partially exposed to the action of the air when annealing it burns out the impurities much more effectual. Pieces of the same casting will be refined and four-fold tougher. Perhaps it is peculiar to only one kind of iron. I have a piece so good it will not harden any more than copper, and when hammered is scarcely inferior to the best refined wrought iron. Pieces thicker were not done through and hardened some.

January 1, 1827.—In the new annealing furnace baked in sand three days, heat regularly increased thirty hours to a silver heat and then slowly decreased to the end, or the 42 hours. Work well annealed, cast from equal parts Sterling, Peru and Sprue; work was too blue, perhaps two-thirds Peru would be better. Work cast from all Sprue about the same color. A piece of iron wire ¼ thick, superior good and blue, which would not harden, was taken out, was crystallized as brittle as common cast iron and not one-tenth as good as the cast work. On heating it in the open fire it changed to a steel-like appearance, breaks short when hammered off thin, hardened like poor and very rotten steel. How is the change accounted for?

A piece of casting has scoria in it, but no bad effect was seen from it. The iron was as tough joining it as the other parts. A piece of good blue malleable cast iron heated and hardened changed to a coarse, steel-like appearance. (Last sentence torn off.)

February 22, 1827.—Examined a tub of castings, about a ton of work. It was not near done, particularly in the middle, although the fire had been kept up four days, but not quite to the degree. A light stirrup lay so that one end scaled a trifle, which was two-thirds done; the other end lay deeper, was not scaled, and not half so much annealed. Pieces of the both ends of the stirrup were packed with other work in a small pot and put in the arch and heated to sufficient heat 18 hours and examined. The pieces two-thirds done before were well done and tough; the other not near done. Thin pieces which came from the middle of the pack and not affected at all to appearance were done tough, and thicker pieces not half done. Some of the work in the large pot had turned blue and soft and every degree from that to hard. The contents of the small pot were put in again and heated 20 hours and examined. Pieces less than ¼ inch perfectly done and larger pieces scanty done, though tolerably good. The small articles would draw out to the size of a small pen-knife blade and tough as the best cast steel. The work in the above named tub not being one-quarter done, or perhaps not affected at all in the middle, the heat had been raised to within a trifle of the degree, but favored the new pot some and lost the heat. Kindled the fire again very brisk 24 hours, after the heat up to the degree 24 hours more, the work supposed to be heated through, as it began to settle, and continued six hours. Settled about 1½ inches. The degree of heat was carefully kept up 48 hours more—though possibly it was a little too hot—the second making four days in all; then closed 24 hours, then brick off 24 hours, then cover off 48 hours, making eight days from the commencement, and then very warm; the work not generally good. The two-thirds Peru brittle and the one-half Peru not much better; may be owing to new pot and much gray work. It appeared to have been done and carbon not sufficiently extracted. In a small case packed with sand and lime, whiter, not clean, but no better; in another small case packed with lime and alkali, white and melted to glass, no difference in the inside through the whole. The more Peru the brighter and brittler. The more it is burnt the brighter and brittler also. Equal halves and well refined may be the best. An article with a large piece or scoria in it was annealed and no effect visible from it; iron packed in pounded scoria annealed six hours, no effect from it. (Sentence torn off.)

April 3, 1827.—At 12 o'clock kindled the fire brisk, and cracked the pot. At 6 o'clock the pot red hot. Packing settled around the edge. Opened and put on the crust. At 12 o'clock at night the heat was up to the degree; kept it well up, sometimes no doubt but what it was above, for 60 hours, then closed the door 24 hours, then the bricks off 24 hours, then the cover off 48 hours, making eight days in all, and a good heat.

The packing was sand mixed with oxide of iron. The work has a white crystallized surface and blue inside. Work packed in clear sand has no white crust, but if refined well free from carbon or wrought iron is crystallized. If a plenty of carbon remains in the iron it will not crystallize, as proved by the tough wire, 1st of January, 1827. Work packed in iron ore containing silex will have a crystallized appearance. If the ore contains no silex there will be no crystallizing.

By a number of experiments and observations it is evident the crystallizing proceeds from silex in some way or other. Pig iron made from ore containing much silex is supposed will not answer, or silex getting into the iron when melted or annealing will be much brittler and coarse. Iron containing much carbon resists the silex, but if the carbon is burned out the silex penetrates it. Much oxygen prevents silex from entering—see October 20, 1826. A vessel packed with one-half or two-thirds of oxide of iron and one-third sand was free from the white crystallized surface that the work had which was packed in sand with but little oxide of iron, and far better. Work packed fully in oxide of iron baked with the above thoroughly done is the best I have ever made. Work packed in Cumberland ore and red oxide of iron ore near the same. The conclusion is that red oxide of rion is important and, in fact, the best thing known for packing, and Sterling well refined the best iron. Sterling well refined, the first melting good. Second

melting better, third melting very sparkling, runs dull, breaks rough when first cast, not in smooth crystals. So free from carbon that silex entered and crystallized. Some white, tough, bend some. One-third pig added and again melted; very superior. Oxide of clay (alum) is good.

May 1, 1827.—Experiment in small way. Baked 18 hours very hot, or rather above a silver heat. Packed in Spanish brown; completely melted; stuck to the iron like burned iron cinder, no remarkable change in the iron. Packed in manganese, melted to a cinder, no important result, rather had the appearance of crystallizing. Packed in decaying Jersey iron ore first calcined, pulverized, the melt too much stuck to the iron, surface not clean, iron bend some, not as good as Cumberland ore, perhaps near as good, but not as pure.

Packed in hard oxide of iron pulverized packing, came out as black as when put in, a little stuck together, iron clean surface and very good. Packed in oxide of iron, as the above, one-sixteenth or near that proportion in weight of saltpeter added to packing, and the iron, except a little spoiled where the saltpeter touched the surface, came out clean and white, pieces of oxide only white on outside, inside black as ever. Pieces of iron one-tenth inch thick perfectly done, bend short so as to touch the sides together all the way around without cracking, thicker pieces done well for the time. The packing stuck together about the same as without the saltpeter.

The sand that stuck to the iron by castings melted to a glass; packed in oxide of iron, one-sixteenth saltpeter and one-sixteenth alum added, work came out black and stuck all over with cinder, not so tough as the above. Packed in oxide of iron, one-thirty-second saltpeter, one-thirty-second alum and one-eighth lime added, the casting covered with a thick scale, although it was perfectly air tight. It acted like sulphur or plaster of paris, which shows that a packing composed of two different materials will destroy the iron when either of the two would answer well alone. Oxide of iron packing turns gray when there is sufficient quantity of anything to revive the iron, but if not it remains black.

July 11, 1827.—At 6 o'clock in the evening packed in fresh oxide of iron with 25 pounds of saltpeter well pulverized, with oxide damp enough to dissolve it. The fire 36 hours in coming to the degree of melting silver. Six hours after it was supposed the work was hot through, or up to the degree, a whitish flame appeared, coming from the crack in the bottom of the pot and also from cracks in the crust of the covering. The heat was carefully kept up under the degree for 48 hours more. No settle of the work or crack appeared in the crust; everything went on well, the best I have ever seen it. Three hours after it was discovered that the fire was too hot and the work was settling. It had settled 3 or 2½ inches. The whitish, bluish flame appeared at the cracks as usual. The fire was suffered to go down and the door closed, making 3¾ days. The flame continued from the cracks 20 hours after the doors were closed. When cooled off the work was found considerably bent; the packing was not melted, but stuck together a little where it lay light and more where it was pressed. The top of the work had a thick soft scale on the surface. The scale diminished toward the bottom of the pot. Whether the saltpeter produced too much oxygen or the scale happened before the crust formed is a question. The former no doubt helped. The scale was so soft as to be rubbed off clean with a chip; the lower part of the work white; the small articles were exceedingly good, and all the work the best I have ever seen made in a large way. Large articles not done through one-thirtieth of an inch on the outside, pure one-fifth, good steel-like by heating red hot and slightly hammering; on the whole, an excellent lot of castings. The pieces that warped would bend back very easily.

September 1, 1827.—Heated four days, 96 hours, twice shut up for three or four hours at a time and no fuel added. Packed in oxide of iron that had been used before, one-eighth new which contained saltpeter. The heat carefully attended to, never much above the degree, settled a little and work bent some, came out of lead or ash color, perfectly free from scale. The color a little changed to blue where the air went in when cooling. The work uniform and good.

Experiment.—A piece of the same article put on outside and one in middle of pot, the outside done very little the best. Packing one-half oxide and one-half ashes; work good, not clean, rusty red color. A piece slightly gray put in a second time very ten-

der yet. A piece of Cumberland iron done through white but brittle; pieces with sal-ammoniac, pearlash, etc., added white; metal no better for it. Several pieces cast in the small experiment put in, which were superior good.

December 7, 1827.—Nine o'clock in the evening began to heat and continued five and one-half days; heat seldom up to the degree; door closed several times four or five hours at a time, and the work not done as the heat above. Evidently the heat had not been sufficient. A supply of one-fifth fresh oxide and five pounds saltpeter added to the packing worked handsome and nice. Packing stuck less than formerly and work bent but little. 9th.—Malleable experiment, rusted iron crystallized bad. A piece that had been annealed well put in with other experiments heated so that hard iron melted and the oxide disappeared. The surface of the annealed piece crystallized about as deep as the carbon had been extracted before. A case heated one and a half hours at a heat that melted copper, packing stuck together, iron done twice as much as would have been at a silver heat.

December 28, 1827.—At 6 o'clock in the evening began to heat and kept up five days. Heat generally to the degree and sometimes above. Work settled and packing stuck together, and the work very bad and bent much, but the best work ever made generally. Some hard castings that were in the heat previous and not done were rendered better, but not good, some soft castings that were not refined from the carbon sufficiently rendered black and brittler, and pot burned through in three or four places. Experiment on a piece of refined casting as generally used, a part of it annealed to show its quality, was tolerably good, rather hard; a part melted in a crucible fluxed with lime apparently much finer and tougher; less carbon. A part fluxed with lime and sulphur remarkably tough outside and about one twentieth of an inch and middle crystallized and bright; little or no appearance of carbon. A part fluxed with sulphur was full of small holes, blackish and brittle; scarce bent at all. Some Rutia iron that would bear melting four or five times without becoming hard was fluxed with lime, which brought it out white with one melting. Some fluxed with lime and sulphur all crystallized and was brittle when annealed. It is evident that lime removes the carbon rapidly, and that a little sulphur had no injurious effect; ore from the Sterling mines, both the red-short and the cold-short, produce the same quality by experiment in the same way. Fluxed with an addition of lime was the finest and best. Hard iron from the same mines and furnace was not as good as that highly carbonated. One-half soft Sterling and hard or square pig too white or sparkling; looked well but rather brittle.

February 10, 1828.—Baked five days; work generally well done, rather too bright and sparkling; some cases chystallized out and free from carbon, next coarse good steel, middle too much carbon. Experiment.—Some fluxed with lime, some with lime and pearlash, some a part annealed iron, some a strong heat but little flux, some the sand stuck to the work and had bent; no particular difference in work generally.

February 22, 1828.—Experiment without a pot; heated the usual time. A hearth was made of bricks surrounded with lime and crust put on as in other cases; the fire played directly on the crust and the work below it packed six inches deep. The work not softened at all except a few of the extreme top pieces, but the lime had attacked the whole work and half scaled away. The arch above the fire was a kind of basin filled about six inches deep, a crust on the packing and covered with lime. The crust did not melt in time to prevent the effect of lime; the work on the surface much injured; it was all sufficiently heated, some of it much too hot. Some of the castings were perfectly free from carbon and as malleable as any iron whatever, and would not harden at all; was brittle and crystallized. A kind of iron that crystallizes by annealing was filed and the filings mixed with charcoal and baked three hours. Afterward melted and annealed, but no alteration. Some of the same melted with pearlash in the crucible, but no good effect. A quantity of work put in a box without packing and placed with the other work, the mouth opened toward the packing, was done as well as that directly inclosed in the packing.

April 1, 1828.—Packed in new large pot, layers of clear packing between the work to prevent bending, but to no effect. An iron bowl filled with castings placed bottom up among the other work; well done and not bent. (Three lines torn off.)

June 4, 1828.—Baked in the small new furnace, the work put in hemispheres 7 inches deep with a grate to prevent the work from falling out, and packed in the customary packing in a large pot of three deep, and heated five days, very uniformly, never more than to the degree required. Two-thirds of the upper part had received no benefit from the packing, was gray and coarse with a slight skin of white, bent some and quite soft, but annealing but little.

June 12, 1828.—Charged the small furnace again, packed the work in hemispheres or pans with the usual packing, except the fine sifted out, and heated five days, but generally a little hotter. One pan was put in without packing the inside, which had the same result; the other was bent less and handsomely annealed. A small experiment in ore that had been burned in the lump during two heatings scaled the work yet. Work cast from iron melted with Virginia coal good.

June 20, 1828.—Charged again as above, except second experiment on old packing that was gray; 6 ounces saltpeter added to a pound of packing came out very white and good. One experiment all new oxide, good; not as white and clean as other. The packing was part new and strengthened with 1½ pounds saltpeter. Heat kept full up; the work good, perhaps the best ever done, but the packing sticks strong. The pot had swelled and oxide filled up so that the fire could not play over the top, and the crust not melted; the crust was not, however, not good.

June 27, 1828.—Fired up again. No crust; put on the coarse packing, the same as above, heat not kept so high, work good, packing stuck less, tops of pans scaled but no scale on work; perhaps the work not quite as good as the work above. Packed in ore that had been used on the 12th of June, did not scale and worked good. Heat kept up five days.

July 7, 1828.—Commenced and other baking charged as above. Experiment.—Pan drilled full of holes, charged with packing, and one with gray packing, and are good, which shows that ore contains more oxygen than scales. The former admitted packing through the holes, which defeated the experiment; hole is burnt through the pot.

July 17, 1828.—Charged again as formerly and made work good as usual; pot worn out.

August 11, 1828.—Began a baking in new pot, packed as formerly; 3 pounds saltpeter added to the packing, covered by dust, though of but little service. The pot swelled and left an opening through the sides which admitted some oxygen. The heat was kept up high for five days, the crust well melted, work very good and fine where the air did not color it.

August 21, 1828.—Set fire for another baking, tried the experiment with the open pot, the pot drilled full of holes. A few large lumps of packing put in, the lumps white through work; not as good as that packed with plenty of packing.

August 31, 1828.—Began again as above and with the same result.

September 26, 1828.—At 4 o'clock in the evening began packing in both furnaces; five days; the large furnace has new six-sided pots six tiers deep, which was well baked, but the casting rather coarse. The small furnace had not been hot enough; the heavy pieces not done and none of it good. Five ounces saltpeter and 4 quarts of packing to 56 pounds casting.

October 5, 1828.—At noon began another baking in small oven sufficiently hot; not good. The work was cast from Sterling iron of a bad quality for the purpose.

October 17,1828.—Fired for another baking; well annealed but not good quality, being of the same quality iron as the two former heats; a part had been baked before passable but not good.

October 26, 1828.—Began again; part iron as above and a part iron made on purpose, which was good; well annealed, but rather dark. Experiment.—Some of the new iron melted several times in a crucible put in a small pot 24 hours, in usual packing; the outside tough as lead, inside not affected so as to bend; probably if the heat had been great enough and sufficient time, no doubt it would have been superior. Very little carbon was left in the iron when cast and crystallizing quality had not got into it. Whether being melted, from the air, or from sand, or from what cause is a question. A piece that had been baked in oxide and sand was dark and tough inside, bright and crystallized on surface; was baked in oxide, crystallized surface disappeared and about as tough as usual.

November 22, 1828.—Began another baking, continued five days; good heat; packed

as usual, in large furnace; some castings very much fluxed and sparkling. A piece only annealed to try; did not anneal at all; crystallized and softened some on outside. A casting sparkling and smoky, near as above. A casting slightly smoky at the close of the heat crystallized on the outside some and dark on the inner part. A piece of same pig as used above melted in a crucible and tried or annealed a day, which produced a tough skin; was put in and annealed five days, was equal to the best wrought iron.

Established size of main pots: Large pot, inside 40 inches wide, 50 inches high, snug 30 inches by 1¼; small pots, inside 30 inches wide and 33 inches high, snug 30 inches by 1.

December 8, 1828.—Began a baking, finished in the usual time; a piece of iron, said to be Amenia, from the town of Amenia in Connecticut, melted in a crucible; as good as Sterling. A piece of Sterling refined in a crucible with a plenty of fire sand; no bad effect from the sand. A piece of the same iron exposed to the blast of the bellows when hot equally good. From the above experiments it appears that the iron must flux and burn, or no bad effect takes place.

December 15, 1828.—Again as usual. Experiments by crucible.—Some blue bottom of a strong pig refined; some of the coarse top refined; but little difference. The blue little the best. Was less sparkling when hard; the difference when annealed was but trifling compared with the difference before melting. The above had not been kept hot enough.

December 23, 1828.—Fired up again with a strong heat; good baking.

January 22, 1829.—Fired in large pot; a part of the work had been baked in small furnace 15th of December but not done, now well baked. Pieces same casting that had not been baked before and ⅛ inch thick tough as a string; the same uniform color all through. Some of the same articles baked in above mentioned heat on the 15th of December were very dark inside and outside skin white, a proof that a strong heat is necessary to make good iron. The heat was probably the hottest and the best heat I ever made. The iron that is burnt or refired the stronger heat is required to anneal it, it is evident. A piece thin and hard, the Sprue was thick and gray moddled, not very good. Crucible experiments: The iron used was from a piece that had been refined in the large furnace in the usual way and the piece annealed in same bundle as the other experiment to see how they compared, which was good.

No. 1, a piece melted with phosphorus, packed in sand; no alteration except a trifle less carbon; good enough.

No. 2, a piece melted with clay; none the worse.

No. 3, a piece melted and lead added and kept hot some time after; no important change, if any not so strong.

No. 4, a piece melted and zinc added as above; little or no change, at any rate no worse.

No. 5, a piece melted and tin added as above; very brittle and large, coarse, bright crystals; no doubt the very cause that made some iron unfit and crystallized as in experiments with different irons.

No. 6, a piece melted and antimony added as above; brittle as coarse earthen; looks a little steely but not so strong as a pipe stem.

January 31, 1829.—Commenced a heat and ran it still hotter; main pot gave out, burnt through; inside dishes crippled by the weight above them, which bent the work some; air passed slightly through the most of the dishes. The work best I have ever made. Experiment.—A piece that had been baked in a low heat and not visibly altered by it was rendered fine and tough; a proof that a strong heat is necessary and that iron refined low or burnt a little must have a strong heat. Experiment.—Piece that sizzled some almost equal to refined wrought. Experiment.—A piece burnt or refined as long as it would run well superior. A piece ¼ inch square bent round paralleled without crack. Experiment.—A piece very strong when cast . . . though nothing remarkable when annealed; probably would have been better if more refined.

Experiment.—A piece that was affected by Virginia coal falling into the hearth on the iron; the iron appeared drossy like lead; when poured was not good; bent some, but breaks black like an experiment by adding sulphur. The above were in a large way in large furnace. Experiment.—In crucible; a piece of defective article melted in a crucible with flux (oxide of iron from large furnace) was very tough. A ¼-inch piece

bent parallel and touched all the way without an appearance of a crack.

Experiment.—A piece of the above melted with flux as above and fine sand; nothing remarkable when poured, but more coarse and brittle when annealed.

Experiment.—A piece of the above same defective articles melted with flux and fine clay; when poured sizzled or blazed violently. Repeated with the same result; when broke was full of holes, and appeared like burnt iron; when annealed was much the same as that with sand; may be tougher, but so full of holes that that could not be ascertained. Remarks.—This, together with the former experiment, proves that sand or clay without flux is harmless and that flux will introduce sand or clay into the iron and that clay occasions much burning or sizzling. The oxide of iron packing after the work is annealed in it becomes gray and contains carbon enough to burn, but the same packing heated in an iron case without cast iron, say a small tight case put in with the work to arneal, will not burn any more than it would before, showing that carbon comes from the casting.

February 5, 1829.—Fired up in small furnace; a strong heat; excellent work.

February 14, 1829.—Fired up again in small furnace; a good heat.

February 28, 1829.—Fired again in small furnace; good heat; main pot burned out.

March 20, 1829.—Commenced in large furnace, new heavy pot; heat continued five and a half days; work good.

May 2, 1829.—Annealed in both furnaces; excellent work; small pot, new and thick.

May 19, 1829.—Again in small pot; work cast chiefly with coal in new melting furnace; good, but heat not quite strong enough; no important difference by being melted by coal, possibly not as good.

June 5, 1829.—Again as usual, small furnace; good.

July 1, 1829.—Annealed in large furnace; burnt through the pot; scaled some of the work and bent very much.

July 18, 1829.—Annealed in large pot by patching it up; completely burnt out; work scaled some generally.

July 28, 1829.—Began again in small furnace; scanty done.

August 6, 1829.—Began in small pot; good heat, but went through the pot.

August 16, 1829.—Again in small pot; good heat.

September 1, 1829.—Again in small pot very much patched; good heat; pot burnt out; casting very uniform and very much improved.

October 9, 1829.—Commenced in brick pot with sheet iron lining filled with packing between the parting dishes as before; fired five days. Gave the pot a coat of lead and clay for glazing, which glazed outside and revived to lead on inside except at cracks, where air got in; sheet iron burnt through; work good, though not so good as would have been if it had been hotter.

November 1, 1829.—Again the same way; better heat.

November 11, 1829.—Again the same; hotter and better.

November 23, 1829.—Again good.

December 20, 1829.—Not hot enough.

December 22, 1829.—Bad heat; run very hot, badly cast; was probably the fault of being burnt; but little of the work fit for use.

December 27, 1829.—Began in small furnace with brick pot; a strong heat; work middling good but bordering on the fault of the 22d; too much hard iron put up for melting.

January 6, 1830.—10:30 a. m., began again in small furnace; excellent heat.

January 15, 1830.—Again good heat.

January 27, 1830.—Again ditto.

February 13, 1830.—Again in both furnaces; good heat.

March 21, 1830.—Again in both furnaces; good; rather sweet.

April 19, 1830.—Ditto, ditto, 24. 0. 21.

May 14, 1830.—Ditto: new iron and bitter, but not quite hot enough; 22. 2. 13.

June 15, 1830.—Ditto; better, 21. 0. 0.

June 31, 1830.—Superior lot of work; small furnace; not as good as the large, 20. 2. 0.

July 4, 1830.—Size and proportion of melting furnace: Depth, 20 inches; back, 15 inches; hearth, 24 inches; arms, 21 inches; main flue, 10 x 10 inches; side flue, 8 x 8 inches, and cover, 4 inches thick.

July 15, 1830.—Annealed in both furnaces; superior work in both; suppose 1. 0. 0.

August 10, 1830.—Again in both furnaces; very hot. The best iron ever made at this works, inferior to none, wrought or cast, in use; suppose 1. 1. 00.

August 29, 1830.—Again in both furnaces; good enough; suppose 22. 2. 00.

September 15, 1830.—Again in large furnace; suppose 18. 0. 00.

October 5, 1830.—Again in both furnaces; very good; 26. 2. 20.

November 19, 1830.—Again in both furnaces; new pot in large furnace; 25. 0. 00. Small furnace not hot enough to make good work.

December 23, 1830.—Just lit . . . oven. 25. 0. 00.

January 7, 1831.—In . . . furnace; work in bad order. Iron bad; 22. 00. New lot of iron . . . some suspicion that burnt iron.

January 30, 1831.—Annealed in large furnace; baked work in part. Strong heat; iron good but not first rate; some suspicion that the new iron is not as good as formerly. Some blue ore was used with the Long mine; suppose 21. 00. 00. pounds.

February 21, 1831.—Annealed in both furnaces; iron passable; suppose 3200 pounds.

March 25, 1831.—Annealed in both furnaces; casting made with patent fuel, which proves the iron better; rosin used for annealing. Small furnace in the old way, large one in clay pots; heated three days only, but very strong. The pots glazed; where the packing came to the air on the pots it cut away the pots, making many cracks in the bottom and sagged. Work scaled at the exposed parts, but good quality.

Deep annealed, the heat had been near hot enough to melt cast iron if exposed outside of pots; suppose 25. 50. pounds.

April 3, 1831.—Again as above; small furnace as usual. Some heavier clay pots; heat slowly raised to 36 hours before it was closed up, in all 66 hours; iron had been kept closer than before, as the pots were glazed some. Heavy clay pots stand much best; work good.

April 10, 1831.—Again as above; small furnace good, the large one with clay pot slowly heated and regularly increased to the end, 64 hours, when the heat was sufficient to melt copper; then shut door 24 hours and slowly cooled. Heavy pot stands well. Iron good, though not annealed as much as above.

April 20, 1831.—Again as above in both furnaces; small one as usual. Some new thick small pots up in heat ran still slower; heat only cherry red at 36 hours and continued 84 hours; good work, clean, harder than before. Pots fail slowly.

April 21, 1831.—One pot filled with work, but no packing; the steam of alcohol conveyed in during the heat; work not quite as good as the other way; covered with soft black scale. A piece of casting annealed as above rather brittle and crystallized was again heated two hours in hydrogen gas and was changed to a tough piece free from crystals and in every sense good. New thin pieces good.

April 27, 1831.—Again as the 20th; small one as usual; . . . heat regularly increasing 72 hours. . . . good. (Several words missing.)

May 4, 1831.—Again as 27th of April; same results, only pot grew thicker and work handsomer; easier to clean.

May 11, 1831.—Again good, rather slack heat.

May 20, 1831.—Again as above; good; tried some new iron said to be wholly from the Long mine; superior to any I ever used. Suppose about some pieces annealed in gas, which was rather crystallized, not first rate. Annealed again as tough as lead and near the same appearance when broke.

Some experiments with nickel added to the iron proved injurious. The heat has been about right on three and a half days. Some of our make of pots superior; only the large furnace used, the small one torn down.

June 1, 1831.—Again good; suppose . . .

June 20, 1831.—Again good; suppose . . .

June 28, 1831.—Again good; suppose . . .

July 4, 1831.—Finished the large new annealing furnace.

July 11, 1831.—Began the heat in new furnace; heated regularly increasing four and a half days. Furnace only partially filled, some new jacks; good heat; suppose . . .

August 1, 1831.—Again as above and good; suppose . . .

August 20, 1831.—Again as above and good; suppose . . .

September 10, 1831.—Again as above and in small furnace with old iron cases; heat two and a half days, very hot; superior work in small furnace, large one overheated.

September 19, 1831.—Again in small furnace as before and good. Repacked the overheated work and heated it to a cherry and cooled off quick. Restored it to the best work ever turned out. The thin pieces before would not bend any.

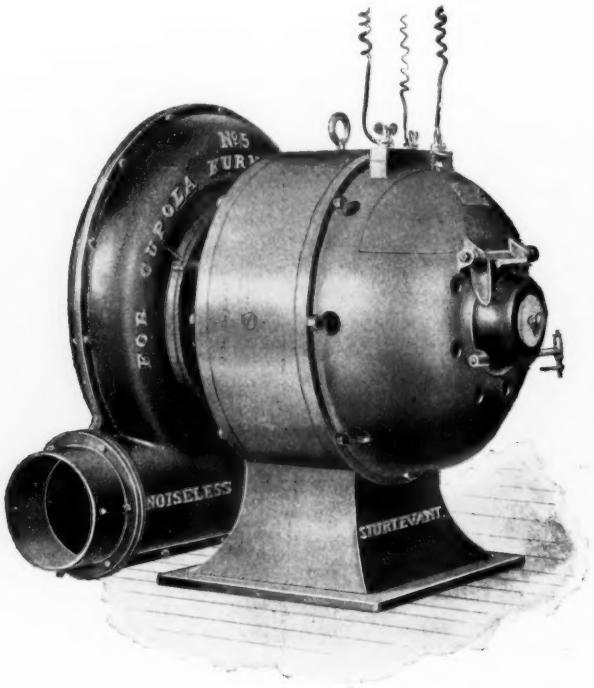
September 29, 1831.—Again in large furnace; passable; little hotter.

October 26, 1831.—Again in large furnace and followed every time.

February 22, 1832.—Finished the cupola Hornett; all 15 days; good work, too. A bad heat by bad . . . through mistake, then good again to July 25th . . . annealed. The iron appears to require more heat . . . brittle when annealed a second time was better, but thick part not good. The new casting the same. The conclusion is the iron was burnt too long in melting. The furnace being worn out did not work well, though heats made of nearly all soft iron were perfectly good and burnt iron appears to be restored by adding highly carbonized iron.

August 10, 1832.—Finished rebuilding the melting furnace about three times larger, which performed well on first trial. Experiment with the Hornet, prepared iron melted with hard coal tolerably good; when fluxed with shells so as to have the cinder run off the iron would not anneal so as to bend at all. Lackawanna coal appears to be better than Schuylkill. One hundred pounds Sprues of casting require a bod of coal, pieces of which Sprue were spotted good. Pieces cast when the hearth was filled up or near the tuyere and the iron exposed some to the blast of the bellows and very hot, though it shrunk badly, was of a fine, very superior quality. Pieces white, hard, and not very strong not good; last drop from furnace good.

September 1, 1832.—In new furnace melted 600 pounds in one hour, ditto 1000 pounds in one and a half hours. Spotted Sprue good for small work, but as soon as it is clean from spots is better for large articles, and a few minutes longer still for axles, &c. The more the iron freed from carbon the stronger heat is required to anneal it; lime on bottom in place of sand; iron equally good. Pieces annealed with a low heat if spotted Sprues will be blacking inside, surface white and crystallized. If it is run longer and cleared from spots it will be hard and bright; if annealed again in a strong heat, both are good. If run still longer more heat is required to anneal it and will be crystallized and . . .



An Electric Pressure Blower.

The inconvenience and waste of power which attends the driving of the ordinary cupola blower at a distance from the cupola is well known to the foundry-man and requires no emphasis here. If the blower is

placed near the cupola in order to avoid piping and loss of pressure, the chances are that it will require an extended system of shafting to conduct the power to it. If on the other hand, it is placed near the source of the power, the losses in transmission of air are liable to be excessive.

Both of these disadvantages are overcome by the adoption of electricity for the motive power, and with its increasing use the opportunity is afforded to the foundry-man to avail himself of this advantageous method of driving the fan.

In the accompanying illustration is shown an entirely new design of electric pressure blower recently gotten out by the B. F. Sturtevant Co., of Boston. It not only contemplates the use of electric power, but also provides for the adjustment of the blower so that it may discharge in any desired direction and thereby save bends in the pipes and losses by friction. To meet the ordinary conditions of the foundry with its atmosphere laden with dust, the motor here shown is entirely closed in a heavy cast iron casing, but it is rendered readily accessible through the door shown. The motor itself is of the multi-polar type, carefully designed to avoid sparking or overheating. It is supported on a substantial spreading cast iron base and the fan is attached to the farther end of the enclosing case. It is then so arranged as to be swung about the motor shaft as an axis so that the fan may discharge in any direction desired. The machine is absolutely stable and readily portable and can be located to suit any desired conditions. The design is patented.

Modern Cupola Practice.

By BERTRAND S. SUMMERS, Chicago, Ill.

(Continued from November Issue.)

INFLUENCE OF OXIDIZED MATERIAL, ESPECIALLY RUSTY SCRAP, UPON MIXTURES.

Little attention has been paid to the peculiar effect of introducing rusty material into the cupola. Only one experience of this kind is necessary to convince a foundryman of the deleterious effect of corroded scrap. The surface rust on pig iron is usually not noticeable, but where corrosion has taken place to any considerable depth a very bad effect is quickly discovered. This is particularly true where light scrap is used, and a large surface has been exposed to the corrosive effect of the atmosphere, in proportion to the small volume. A prominent effect in bad cases of this kind is to make the iron exceedingly dirty and spongy, and when this dirt is noticeable, the cleaner the material introduced into the cupola the cleaner will be the casting obtained. The writer was confronted some time ago with a serious complaint of dirt in the iron, and on investigating the case found it due entirely to light scrap which had been seriously coroded. Upon the dropping of this scrap from the mixture the trouble entirely disappeared. There is very little doubt that, in many cases, spongy iron poured from the cupola is traceable to the use of corroded material. Besides this inconvenience, material of this nature tends to harden the iron to a limited extent. But this is not nearly as noticeable as the former effect, and cannot be detected in iron high in graphitic carbon.

EFFECT OF THE BLAST.

There is scarcely any one factor in cupola practice deserving of more close and constant attention than the blast. There are reasons to believe it exerts considerable influence in furthering the mutual reactions of the different elements in the metal, but this has not been clearly demonstrated in the tests thus far made. Aside from its effect in this way, increase of blast seems to have a decided tendency to increase the total carbon in the cast iron, and correspondingly to increase the percentage of graphite. As demonstration of this, the composition of the irons in the following table, which were made from the same mixture at different dates, may be interesting:

Table IV.—Analyses of Castings from the Same Mixture.

	I.	II.	III.	IV.	V.	VI.	VII.
Silicon	2.30	2.74	2.03	2.27	2.04	2.10	2.21
Graphitic carbon	2.98	2.59	2.98	3.07	2.90	3.11	3.06
Total carbon.....	3.44	3.15	3.67	3.52	3.61	3.74	3.63
Pounds of iron per pound of coke	6.4	5.4	6.2	6.3	7.6	7.6	7.0

The first three members of this series were cast from a larger cupola than the remaining members. Only the third iron shows a higher carbon content that compares with the last three. The blast apparently varies. Iron is sometimes poured which can only be accounted for in this way. If II is contrasted with I and III a decided difference is no-

ticed; also III differs considerably from I and II. These irons are all made from practically the same mixture, and are here mentioned to show the anomalies that are so common in foundry practice. Unfortunately, reliable measurements have not been secured on blast pressure, but, inasmuch as the air is supplied by an open blower, the amount of air passed through the cupola would be largely dependent upon the resistance found in the cupola itself. The true criterion of the effect of the blast is the amount of air passed through the cupola in a given time, and not the blast pressure. Whenever an attempt was made to measure the blast pressure it was always found to be practically the same, even when both cupolas were run at once. The explanation of this is obvious. Inasmuch as the fan is not entirely inclosed, the pressure can never exceed a certain maximum, or air will be forced back through the fan. In the case here cited the fan was somewhat overworked, and probably air was being forced back through it. It would thus happen that, if the burden offered more resistance at one time than at another, less air would pass through the cupola at that time. This would seem to be the explanation of the difference in these three irons made from the same cupola. This hypothesis is apparently verified when the remaining four members of this series are considered. These four irons are compounded from the same pig irons as the first three, as are also all the irons in Table I. The mixture has been varied but slightly, and if any difference could be expected from this cause the irons in Table I should show higher carbon contents than those of Table IV. The last four irons of Table IV were melted in the same cupola as those of Table I, but more air was passed through the cupola in the former case. Also more air was passed through the cupola in melting the last three members of Table IV than in melting No. IV of this table. This was accomplished by using more tuyere openings. In the case of iron IV two openings in the upper set of tuyeres were used, besides the full lower set. But with the last three irons of this series the full upper, with the full lower set, was used. With the irons of Table I only the lower set was used. Contrasting iron IV with those of Table I, a higher content of total carbon is noticed, and also a corresponding rise in the graphitic carbon. Again, comparing members V, VI and VII with IV, the same thing is noticed. This is particularly noticeable in VI, and is probably due to the causes mentioned above. These tables do not appear to demonstrate that silicon has had any greater effect in promoting graphite under the effect of the increased blast. It may be that if the blast pressure were increased to a still greater extent an effect would be noticeable. It would seem almost a demonstrated fact that the temperature is the governing factor of the effect of silicon, and the temperature of the cupola is certainly increased by increased blast, if a certain maximum be not exceeded. This limit is seldom reached in foundry practice, and faulty iron is more frequently due to a scarcity of air than to an excess. The blast is probably one of the most important factors in foundry practice, and many of the mysteries not yet explained may be traced to its door. There is scarcely any doubt that it has a marked effect upon the content of total carbon, and it is not unlikely that when the results of further investigation are known, the amount of air passed through the cupola will be found to condition, to a certain extent, the effect of the metalloids in the iron.

IRON MIXTURES AND IRON SPECIFICATIONS.

An attempt has been made in the foregoing to demonstrate that the desire for silicon has been carried to an extreme. This desire has become a mania in some quarters. If the foregoing tables prove anything, they certainly prove that high silicon irons are, in many cases, a useless luxury. A certain amount of silicon is undoubtedly necessary, but the plan of gauging the value of irons by their content of silicon is but one step in advance of the old fracture method. The carbon is undoubtedly the governing factor in irons, and the most radical advocate of silicon can do nothing with foundry mixtures without a certain carbon content. It seems, then, that total carbon is one of the most important elements to specify in purchasing foundry irons. The writer has yet to meet with an iron too high in carbon to be of excellent use in the foundry. It has been the custom in our practice to specify 3.75 per cent. of total carbon in our No. 1 iron, especially when charcoal irons are purchased, while a very lenient specification is allowed in silicon, it being, for charcoal iron, not below 1.50 per cent. The furnaceman is allowed to have silicon about anywhere he

wants it as long as he can furnish iron with the necessary carbon. A minimum graphite specification is also inserted in nearly every case. The philosophy of this is obvious from the foregoing. In the cupola comparatively little combined carbon is changed to graphite, and this is especially true when the heats are small and, consequently, the heat developed is not sufficient to produce any marked change in this direction. This fact can easily be demonstrated in practical work, where frequent analyses are made of daily casts, and the compositions of the irons composing the mixture are known.

In these specifications the minimum is specified, and any variation must be above the limit. This is thoroughly practical, and has been in operation long enough commercially to demonstrate its value. It is difficult to get iron merchants to make carbon determinations, but they will agree to furnish iron under specifications requiring certain minimum limits of total carbon and graphite. Whether the latter is specified or not, there can be no doubt about the necessity of specifying total carbon. Very little attention is paid to silicon in the work, as most of the high carbon irons will carry sufficient silicon for most classes of work. However, it is often useful to require a certain silicon content in the iron, so as to get sufficient graphite, as the heat of the blast furnace is sufficient to enable the silicon to control the graphite to a great extent. In the best snap flask work, where a large proportion of charcoal iron is used in the mixture, 2 per cent. of silicon is found to make elegant castings, and in such mixtures no ferro-silicons are used; but a high silicon coke iron, carrying over 3 per cent. of silicon and about the same of graphitic carbon, is used. This gives good results, especially where a high grade of machinery castings and fine snap flask work are poured from the same mixture. This is further substantiated by analyzing some of the best castings of tools and machines that can be found on the market. Some of the best known firms making this class of work will be found to be using this variety of iron. With coke iron it is well to run the silicon a little higher, although for machinery work it is best not to have it too high.

When trouble is experienced with open or spongy iron, and it cannot be traced to some such cause as rusty scrap, a good procedure is to run the total carbon in the casting as high as possible. This will give a higher content of combined carbon, and at the same time the high content of total carbon, while the graphite, usually increased slightly in this way, will keep the iron soft. When this is done it is well to consider the content of silicon, and if this is much over 2 per cent. a decrease will be found beneficial.

THE USE OF CARBON.

As mentioned in the first portion of this paper, silicon is commonly believed to enable a mixture to carry more scrap. This belief is open to serious doubt. It is obvious that if a mixture is running low in carbon, and ferro-silicon is added in greater amounts to enable the mixture to carry more scrap, this procedure will not only fail to enrich the carbon content, but will actually impoverish it. The reason for this lies in the fact that high silicon iron carries less graphitic and total carbon than a good scrap, and much less than a good cast iron. For this reason it is evident that when ferro-silicon is added to the burden it is certain to lower the content of carbon in the cast iron somewhat. Inasmuch as the iron is dependent upon carbon for its softness, it is open to grave doubt whether, by increasing the silicon and thereby decreasing the carbon, by adding ferro-silicon, any more scrap can be carried and the same quality of iron poured from the cupola. The amount of scrap that can be loaded into the cupola without changing the quality of the iron is dependent upon the carbon, and especially upon the graphite. Even if we admit that an increase of silicon can cause an increase of graphite, yet, if there is not sufficient carbon present to be changed into graphite, the graphitic carbon cannot be obtained in the required proportion. Further, when it is doubtful that silicon will cause any appreciable increment in the graphite, it is open to question if the ferro-silicon does not tend to lower the scrap carrying ability of the mixture.

A high carbon mixture averaging, for example, 3.10 per cent. graphite, and about 2 per cent. silicon, will carry considerably more scrap than a mixture containing over 3 per cent. silicon and lower in graphitic carbon, or in a mixture impoverished in total carbon, no matter what the silicon content. This assertion can be proved in practical work,

and it would seem that the popular idea to the contrary is based on a fallacy.

The carbon determinations in the foregoing tables were all made by the oxygen combustion method, and the greatest care was exercised to insure accuracy. The determinations have been checked, and the results from the furnaces used, checked with results from other laboratories. In this connection, thanks are due to E. J. Ericson, whose excellent work in this particular has greatly aided this investigation.

In conclusion, it should be mentioned again that the fan supplying the air to both of the cupolas employed in this investigation was somewhat overloaded. Therefore, it is possible that foundries supplied with better blast facilities will obtain results different from the above; that a greater effect of the silicon will be noted, and perhaps a greater benefit traced to the use of ferro-silicons. If this should be so, it would only go to demonstrate the effect of the blast in foundry practice. It is hoped that any members who may have noted different effects from those outlined above will make their observations known.

CAST IRON NOTES.

Devoted to Inquiries from Practical Foundrymen on the subject of Melting and using Cast Iron. Address all Inquiries to W. J. KEEP, care of The Foundry.

FOUNDRYMEN AND FOUNDRY TESTS.

Are we entering upon an era of foundry tests? Without doubt we are. Are founders prepared for this? Most decidedly not. Why not? Founders are confused by the disagreement among those who advocate the use of tests. The average founder does not understand how to use tests.

What is needed is a clear statement of those principles that are essential, and the leaving entirely alone all that is unnecessary. There are three distinct tests and any founder can use them:

1st. Chemical analysis, knowing the composition of the pig iron producing the desired grade of castings.

2d. Mechanical analysis, by the measure of the shrinkage of a test bar producing the desired grade of castings.

3d. Finding the actual strength of any size of casting by breaking a test bar.

The first and second are two ways of arriving at the same result, uniform grade of castings.

With chemical analysis the approximate percentage of silicon in the irons charged in the cupola must be known. By varying the irons a desired percentage of silicon is put in the casting and a definite physical character of casting is expected.

With mechanical analysis the definite physical character, which is shrinkage, is measured, and if it is too high the silicon is increased, if too low pig iron or scrap containing less silicon is added.

Either of these methods will produce castings of practically the same grade each day.

For the use of either method the following facts should be known:

The greater the percentage of carbon in the pig iron and the more of it graphite the better, but if the grain is clear and uniform and dark the founder had better drop this fact from his mind.

The influence of silicon is to decrease combined carbon which exists in hard iron, and to increase graphite which is found in soft iron. More silicon is needed to soften small than large castings because the slow cooling of large castings gives a smaller amount of silicon time to exert a greater influence. Aside from the grain and color the influence of silicon is shown by its lessening of shrinkage.

To apply chemical analysis: If the founder knows the silicon in each carload of pig iron and he knows how much silicon his castings should contain, by having one iron with more silicon than the rest he can figure out a mixture to suit his purpose, but as a given percentage of silicon does not always exert the same influence it is necessary to measure the shrinkage to ascertain its influence and to find whether more or less silicon was needed.

To apply mechanical analysis he does not ask for accurate analyses, but must know from the maker or from his experience which in his yard are hard and which are soft irons. He makes his mixture so that he is sure of enough silicon and then is guided entirely by the measure of shrinkage as to whether more or less silicon is needed.

The result by both methods is the same, but the latter needs less calculation and does not require expensive analyses, and there is

less chance of error, as the actual influence of silicon is the guide.

The shrinkage of each size of casting should be as nearly as possible ⅛-inch per foot.

If castings of various sizes are to be made the same day, and each is to have a shrinkage of ⅛-inch per foot, it would be necessary to have iron delivered from the cupola having more silicon for the small castings and less silicon for the large castings.

Do not allow the influence exerted by sulphur, phosphorus or manganese, combined carbon or graphite to occupy your mind until you learn to produce exactly the grade of castings that you require, and become perfectly familiar with the influence of silicon.

The question of strength is entirely a different matter, and though influenced by the chemical composition the strength may vary greatly in castings having the same composition. Strength depends entirely upon the character of the grain. Fast cooling produces a fine grain and slow cooling of the same iron produces a coarse grain.

To produce the closest grain and greatest strength in large castings put iron into the cupola that has a close grain and that has low silicon.

Now comes the question of test bars. The United States Government has placed its foundries in charge of engineers who are accustomed to all kinds of tests, and who have made a study of the relation between the percentage of silicon and the size of castings. The result of this experience is that to have a test bar show the actual strength of a casting from the same iron, the test bar must be cast of the same thickness as the casting, and must be attached to it so that it will cool just as slowly. There is no possible doubt but that this conclusion is correct, but to make and break bars the actual size of each casting would be so expensive as to be impracticable.

A relative test of strength determines the strength of one or more sizes of test bars from the same iron as the castings; then by comparing these with previously made tests showing the variation in strength due to variations in size of casting, the strength of any size of casting from that iron can be very closely approximated. This is within the reach of every founder.

Remember that the uniformity of the grade of castings is determined by a variation of silicon, and the test of grade is the measure of shrinkage.

The only way to find the strength is to break a test bar, but this will not insure uniformity of grade.

The cost of making these two tests is very small compared with the saving on account of uniform quality.

It would seem that all founders would apply these principles at once.

Correspondence.

Editor of FOUNDRY:

Dear Sir.—I accidently stumbled upon something that may be of some use to some of the readers of THE FOUNDRY. It may not be new to others, but it is to me. It is a simple and quick way of finding the weight of a round plate one inch thick and any diameter. I give an example of the old way of finding the weight and my way.

THE OLD WAYS.

32			
32			
64		32	
96		32	
1024	Sq. of Dia.	64	
.7854		96	
4096		1024	Sq. of Dia.
5120		.7854	
8192		4096	
7168		5120	
804.2496	Area.	8192	
.26		7168	
4825.2976		4)804.2496	Area.
16084992		201.0624	Weight.
209.102896	Weight.		

MY WAY.

32	
32	
64	
96	
1024	Sq. of Dia.
.2	
204.8	Weight.

Yours truly,

WM. F. CORKEM,

Vulcan Foundry Co.,

Pawtucket, R. I.

Editor THE FOUNDRY:

Dear Sir—Recently we furnished a gear wheel about 8 feet in diameter to replace a broken one in which the second wheel was ¼-inch larger in its pitch circle than the original wheel. This was no doubt due to shrinkage, but it occasioned our customer considerable trouble in getting it into place. Our customer claims that the wheel should have been exactly the same size as the first one, as we had the pattern for the first wheel, and he expected the second one to be exactly like the first.

These wheels were both made from the same pattern, and a subsequent wheel made from the same pattern was smaller than either of the other two.

Can you account for this, or would you have some of your many authorities express an opinion as to whether it is possible to make two castings of that size exactly the same diameter when made at different times?

Your reply through the columns of THE FOUNDRY will greatly oblige,

Yours truly,

ROBINSON MACHINE CO.,
Monongahela, Pa.

Cohoes, N. Y., Oct. 30, 1898.

To the Editor of THE FOUNDRY:

A few weeks ago I saw in THE FOUNDRY, I think, a piece relating to the length of life of a cupola lining. We are running a No. 2 McKenzie cupola. On May 30, 1897, we lined it up from bottom to top of charging door, and it lasted until the first week in August, 1898, a period of fourteen months, only requiring patching once or twice in the melting zone. We could have run it some time longer, but the stack above had not been lined in fifteen years, and commenced to crumble and bricks kept falling out, so we had to put in a new lining clear to the top. We have averaged about 7,000 pounds per day; use Lehigh coal for part of the bed, the rest of the charges, coke. Have to melt our iron hot, as we have a good deal of light work, and a long distance to carry the iron, as the cupola is at one end of the shop, with the crane floors next to the cupola. Shop is 150x60 feet. Our average time of running off a heat is 50 minutes; we have run some heats of 9,500 pounds in 1 hour and 15 minutes. The cost of lining was about $75. I thought this would perhaps be of some interest to you, as I find a great many items of interest on foundry practice in your magazine, and would not be without it for anything, for it is full of good things relating to the foundry.

T. E. PEVERLY.

The Pewabic Founders.

By HENRY HANSEN.
(By Telegraph.)

The annual outing meeting of the Pewabic Founders was held last Friday at Coon Hollow. A party of 60, mostly anti-foundrymen, left Pewabic on the mudscow Alice G. Rubberneck at 9 a. m. on that day, spending a delightful bright morning on the Pewabic River, the beauty of which was marred only by a few snags and sandbars, the bar on the boat not included. While passing Paradise Flat it became necessary to take a reef in the flying gib and to heave overboard some ballast in order to pass the obstructions to navigation at that point. This was accomplished by unloading a sufficient number of anti-foundrymen to reduce the draft, after which a boiled New England dinner was served on the poop deck.

After the boat had been tied fast to the landing place at Coon Hollow, the voyagers were met by a delegation of representative Coon Hollow foundrymen and by a number of visitors from neighboring cities who had driven in the day before and slept in the livery stable over night. The Pewabic crowd were first taken to the extensive plant of Flux McFadden, covering one-sixteenth acres, where Flux himself conducted them through the immense establishment, giving them an opportunity to investigate his manner of bedding in grate bars, etc. His method of turning out sash weights was also much admired. He has never been in the hands of a receiver, and has a large export trade with surrounding farms in exchange for wood, butter and eggs.

A banquet was prepared for the visitors at the Hotel de Mud at 7 o'clock. After the turnips had been passed around, President Pumice De Witt, acting as toastmaster, made the members keep quiet while he introduced Peter Snickelfritz, superintendent of Flux McFadden's foundry department. Peter delivered a hearty address of welcome, and expressed his pleasure at getting all he could eat at the expense of someone else. Toasts were next in order on the bill of fare, and

Prof. Hink Hokum responded with one labeled "The Roof, and its Relation to a Foundry"; Constant Humpon spoke of "The Importance of Earthquake-proof Foundations for Tumbling Barrels"; Sublime Cannon of the Rainbow Chaser Co. exhibited indicator diagrams showing the "Effect of Shortening Rapping Bars," and Major Pochannis read a touching poem entitled "Semi-Steel Castings, or, How to Get Something for Nothing." Many of the members were visibly affected, especially those who had paid for the first installments of the process by the same name.

The President asked someone to present a topical question for discussion, and John Gaggerless suggested that the association take up the one marked "How to Reduce the Cost of Melting," on which the hair had begun to grow out again. Mr. Gaggerless said that he had been a close student of foundryology, and several times when someone had shown how to put more iron and less coke into a cupola, he had followed their directions —to his sorrow. He had discovered that many people who said they melted iron economically merely thawed it out, while other metallurgical engineers in quoting records merely notated what they thought so many pounds of carbon + so many pounds of oxygen ought to do, without wasting time to prove the correctness of their answer.

Albert Liverwurst, Consulting Electro-Metallurgical Expert to the Skinner Co., of Skinapolis, said that he had reduced the cost of melting iron wonderfully by using roller bearings in the blast pipe. As is well known, the friction of wind increases as the square of its velocity. The resistance of a solid blast pipe materially reduces the units of oxygen in the air, and causes it to increase in ash and volatile matter, requiring more limestone or fluor spar to reduce it to oxide. With a blast pipe lined with roller bearings throughout, the friction is reduced to the minimum and the air can be kept in as perfect a state of preservation as a carcass of beef in one of Armour's abbatoirs.

Wayback Gulliver declared that while the previous speaker's tobacco might be first-class, his principle was wrong. Friction, instead of being injurious, positively benefited the air as it elevated the temperature. The hotter the air forced into the cupola the less fuel consumption. Instead of putting roller bearings in the blast pipe, Mr. Gulliver advocated to drive it full of ten-penny nails on which the air would tear itself to pieces, and passing through which it would be heated automatically.

After further debate, participated in by Messrs. Mudtucker, Bosphorus and Snort, it was decided to refer the question to Edward Atkinson for settlement.

The Secretary announced that the association had purchased a magic lantern at a fire sale, and that after being repaired, same would be at the service of any member who entertained political aspirations.

The chief emotional feature of the meeting occurred when Prudence Skinflint read his paper on the "Inspection of Claywash," the members receiving it while standing, in order to catch the delicate notes passing along the ceiling. It is as follows:

"Although the discussion of foundry topics has been of all colors, wonderfully varied and voluminous, yet there is one branch of the business that has received very little attention either in the trade journals or in the papers read before the various foundrymen's associations, and that is the matter of inspection of claywash.

"In some foundries there is no regular claywash; in others it is very thin, while here and there it is employed so as to produce the best results.

"My own experience convinces me that a properly conducted system of inspecting claywash is productive of greater benefit to mankind than any other branch of management. I repeat, I am convinced that a properly conducted system of inspecting claywash is of more importance than any other feature of a foundry manager's rosy career, outside of his diet. No doubt it will appear to some that I am talking through my hat (a voice: You are), but the day is past when tolerable claywash will satisfy the public clamor for perfection.

"Just think! Before our war with Spain, whenever claywash was needed the molder would send his helper out for a shovelful of clay. This the helper would deposit in a bucket, subject to sight draft. The molder would deposit sufficient water to cover the deposit of clay. If the weather was cold, the molder would order the helper to amalgamate the two elements. After the helper had taken his time to do this, the molder would test the

elongation of the saturated solution of claywash by putting the end of one finger into it. If the transverse strength of the claywash was not up to standard specifications, the molder would order the helper to get a handful of flour. The helper would add this to the solution and stir it. The molder would insert his finger. Verily, this was an age of 'rule of thumb'—if the molder used his thumb.

"To-day we are mixing our claywash according to this very description. Members of the Pewabic Founders, will you save our trade? Where is there science in this method of mixing claywash? Where is the advance in founding of which you boast? A century has elapsed without any improvement in claywash, and the youth of the land prefers to let you paddle your own canoe. If you want to attract him, introduce science. If you want to make money, get a carload of science into your shop. Without science a foundry is like the Democratic party without an issue.

"To begin with, the place for the inspection of claywash should be a pot large enough to hold a day's supply, and it should have sufficient light to reveal the least imperfections at a glance.

"Before placing any clay in the pot, the inspector should see that all rocks and stray spikes from the previous day's supply are removed, if necessary, by the aid of a microscope. These articles are injurious to good claywash, as they increase its specific gravity.

"As the amount of clay that can be held in solution depends upon the temperature, it is recommended that a small spirit lamp be placed underneath the claywash-pot to keep its temperature normal. By inspecting the lamp very carefully and keeping it filled, a perfect claywash is obtained with very little outlay—in fact, scientific improvements cost next to nothing.

"Many benefits accrue from a perfect inspection of claywash. By being of the right density it lengthens the life of gaggles by keeping the carbon in the graphitic state. It also reduces the cost of insurance as it furnishes a semi-fireproof coating for flasks, soldiers, and the like when squirted thereon in liberal quantities.

"Much has been said about painting by compressed air, but none have so far suggested the fortune awaiting the foundrymen who utilize this agent for distributing their claywash on all spots likely to be heated. The slow method of claywashing by hand with a bald-headed brush is expensive, and must give way to the march of science before the silver standard is adopted."

After the President had called attention to the questions of vital importance suggested by the paper, Prof. Christopher Holsox unbuttoned his vest and let out part of his wisdom, habitually contracted by mechanics, whose hardest labor is to make after dinner speeches. The professor told how he would run a foundry if he had one. All of the members expressed the opinion that Mons. Holesox would be a red-hot foundryman, as long as his credit would hold good for pig iron and coke.

After benediction the visitors started for Pewabic in single file. Before adjournment resolutions were passed indorsing the work of the anti-krout society.

Among the Foundries.

E. J. O. Davidson and Scott Coates will erect a foundry at Ellwood City, Pa.

William Ward has sold his foundry on Treat Island, Me., to T. W. Chapman & Sons.

I. A. Brown has purchased the foundry business of Thomas Stewart at Allegan, Mich.

Shetter & Flannigan, of Steubenville, O., have closed their foundry for an indefinite period.

The penitentiary foundry, at Portland, Oregon, has started up, giving work to 125 convicts.

The Kepp Gear Wheel & Foundry Co., of Allegheny, Pa., have made an assignment. Assets, $24,313.63.

The foundry business, especially in malleable iron, is reported as very brisk for a year past at Indianapolis, Ind.

The strike still contines at Pero's foundry, Worcester, Mass. Each side is determined and no solution is in sight.

St. John & Shumacker, of Fairmount, Minn., has dissolved partnership and Vic St. John is now in full control.

The Springfield Machine Tool Company has moved into its new foundry, an elegant and well-appointed structure.

John Chedester and A. McQueen bought the Barker foundry, of Braidwood, Ill., and have started it in operation.

The Co-operative Stove Co. has been organized at Wheeling, W. Va. They will make stoves and heavy castings.

The brass works at Haydenville, Mass., are being run by the assignees. It is expected they will be fully occupied soon.

Homer Charles, of Deadwood, has leased from Job Mills his foundry at Rapid City, S. D., and will put it into immediate operation.

Aaron Wissler, of Braunnerville, Pa., whose shops were burned, has built a new machine shop and foundry and will soon start up.

At the annual meeting of the Keystone Foundry & Machine Co., of Kutztown, Pa., the entire board of officers was unanimously re-elected.

James F. Powers, proprietor of the Elkton Foundry, Elkton, Ind., has completed arrangements for the removal of his plant to Garwood, N. J.

The Lithgow Mfg. Co., St. Louis, Mo., one of the oldest and largest stove foundries in the South, is to be liquidated. Declining business is the alleged cause.

The foundry of the Adirondack Machine Co., at Carthage, N. Y., has started up for the first time since the Stiles Company, of Watertown, obtained possession of it.

The Crescent Foundry & Construction Co., at Allegheny, Pa., has sold its plant to the Consolidated Gas Co., and is looking for a new site, on which to erect a plant.

The people of Keokuk, Ia., have subscribed $10,000 to repairing of the old Keokuk foundry, and Chauncey Castle, of Quincy, Ill., will put it into operation, employing 50 or 60 men.

On application of the directors, George A. True has been appointed receiver of the Frontier Iron Works, of Detroit, Mich. Lack of profit suggested the closing up of the business.

Peter S. Maronian, the watchman employed by Prospey Pero at his foundry in Worcester, Mass., who stabbed a man, has been suspended until the strike shall be ended.

The Pennsylvania R. R. Co., at its shops in Altoona, Pa., has cut wages generally, the molders having suffered a cut of 5 cents per wheel, which is a cut of 90 cents on the day's work.

The Titusville Iron Co., Titusville, Pa., will add a building of brick and iron to its radiator plant, 418x80 feet. They use a new machine for molding radiator sections and save iron thereby.

For the second time, recently, the foundry of Walker & Pratt, Watertown, Mass., has been compelled to shut down because of inability to get iron. A strike in the Pennsylvania iron mines is the cause.

The "Farmer" Foundry, Rochester, N. Y., which has been closed for a long time, has been purchased by the brothers, Charles and Wm. B. Timms, of Watkins, two experienced foundrymen, and will speedily be put in operation.

The Eagle Stove Foundry, at Fall River, Mass., started up with a full force of men. Its name has been changed to Mechanics' Machine & Foundry Company, and they are turning out brass castings and electrical supplies.

The two plants of the Lebanon Boiler, Foundry & Machine Co., Lebanon, Pa., will be sold at public sale Dec. 6. Wm. G. Miller, of the Pennsylvania Steel Co., it is reported, is at the head of a syndicate to buy the property.

John Paisley, a workman, was accidentally shut in the core-oven at the Janesville foundry, at Janesville, Pa., and was nearly suffocated when his feeble tap on the door was heard and he was rescued. He was unable to speak when released.

The Rogersford Foundry & Machine Co., of Rogersford, Pa., is engaged upon an order for thirteen tumbling mills for the J. W. Paxson Company, of Philadelphia. This mill is of an improved pattern, and is giving general satisfaction wherever used.

Forty-one molders at the foundry of Bingham & Taylor, Buffalo, N. Y., struck for a minimum rate of $2.25 per day, the abolition of piece-work, and recognition of the shop committee. The firm at once conceded all demands and the men returned to work.

The report of the receiver for the Heilman Machine Co., of Evansville, Ind., for five months to September 21, shows $22,000 net earnings, or 11 per cent on the capital. The receiver has been ordered to pay 15 per cent on the company's indebtedness and to continue the business.

The Superior Drill Company, of Springfield, O., has purchased and taken possession

of the Amos Whitely shops in that city. This will give the company vastly more room, of which their business was much in need. These works originally cost $350,000, and were bought by the Superior Drill Company for $76,500.

Davis & Thomas, of Allentown, Penn., have added another improvement to their immense foundry and machine shop, until they are now equipped with everything in the way of labor-saving and time and distance annihilating appliances. The latest in this direction is the connection of every department in the plant by telephone with the main office, thus affording instant and easy communication with every foreman and head of any department throughout the establishment.

S. D. Worden, the Syracuse foundryman, has suddenly disappeared. A letter received by a confidential assistant from Washington says: " * * * I have done my best to secure contract for shells, but have not succeeded. I made up my mind when I started from home that if I did not get contract for shells that I would not return. My reason for this is that I am owing about $4,000 more than I have anything to pay with. * * * Keep my going away as quiet as possible." The works will continue in operation.

New Buildings and Enlargements.

William Ward, of Oldtown, will build a foundry in Milford, Maine.

At Cobbleskill, N. Y., Ira Rickard is enlarging his foundry building.

The Chicago Hardware Foundry Co. will erect a foundry at North Chicago.

The C. H. Dutton Co., Kalamazoo, Mich., have built a foundry 60x120 feet.

J. M. Cochran will establish a foundry and machine shop at Aiken, S. C.

The Tacoma (Wash.) Brass and Model Works will build a new foundry.

A brick addition is being constructed to Laytham's foundry, at Pasaic, N. J.

At Wallingford, Ia., Kasa & Wahler are building an addition to their foundry.

A new wheel foundry will be built by the St. Charles Car Co., of St. Charles, Mo.

The Goulds Manufacturing Company, Seneca Falls, N. Y., are building a new foundry.

Richard Meisterknecht is erecting a brass foundry 40 feet square, frame, in Allentown, Pa.

The Chester (Pa.) Steel Castings Co. has just completed a large addition to its foundry.

It is reported that the Thomas Furnace Co., of Niles, O., will build a large foundry at once.

The National Iron Works foundry, lately burned, will be rebuilt on a much enlarged scale.

The D., Y. & A. A. R. R. Co. has voted to erect $18,000 repair shops at Ypsilanti, Mich.

The Scribner & Conchar Co., of Dubuque, Ia., will build a new foundry, to employ 40 men.

Wm. Bates is building a foundry at Portland, Wis., 20x60 feet, two stories high, with a leanto.

The capacity of Golden's Foundry & Machine Shops, Columbus, Ga., is to be doubled, in anticipation of increasing business.

The Hood Machine Co., of Birmingham, Ala., will rebuild its burned foundry at a cost of $15,000.

A. B. Collier is building an addition to his foundry at Harrisburg, Pa., to be used as a motor house.

The Northwestern Wire Mattress Co., of Kenosha, Wis., has enlarged their foundry to 200x90 feet.

The W. F. & John Barnes Company, of Rockford, Ill., is adding 100 feet, four stories high, to its factory.

The Troy Malleable Iron Works Company will build a $15,000 addition to its plant at Watervleit, N. Y.

The American Foundry & Machine Works, Bowling Green, O., will build a 60x80-foot addition to foundry.

The Eberhardt Mnfg. Co., Cleveland, O., is adding a new department for the manufacture of annealing pots.

The Lippert Foundry & Machine Co., of Kenosha, Wis., contemplate building an addition to the foundry.

Parties with large capital contemplate building a foundry at Toledo for the manufacture of heavy machinery.

The Illinois Steel Company will build an immense new foundry at South Chicago, to cost, with equipment, $250,000.

The John Deere Company, Moline, Ill., has built a $40,000 grinding shop, and are also building a new foundry.

The Merrill Iron Works, at Merrill, Wis., recently burned, have been rebuilt and are now larger and better than ever.

Irving A. Brown, of Allegan, Mich., has purchased the foundry business of Thos. Stewart, and will enlarge it soon.

The Addyston Pipe and Steel Company contemplates building an immense new pipe foundry at Birmingham, Alabama.

W. F. Foos will build a new foundry of 11,360 feet floor space in Springfield, Ohio. Also, a fire-proof vault for patterns.

It is reported that the Robinson-Rea and the Leechburg Foundry Companies will consolidate into one large concern at Homestead, Pa.

The American Steel Castings Co., with main offices at Thurlow, Pa., has declared a dividend of three per cent, payable November 7.

The recently completed addition to the Wisconsin Malleable Iron Works gives employment to 65 more men, 700 being the full number employed.

A new foundry company is incorporated at Lincoln, N. J.; $2,000 capital. Incorporators: Wm. H. Kenyon, Howard B. Tapscot, and Dan'l J. Pierce.

The Connersville (Ind.) Blower Co. has awarded to the Newcastle (Ind.) Bridge Co. the contract for erecting a steel addition to its foundry 60x60 feet.

The Grant-Forris Co., who are building a new foundry at Mechanicsville, N. Y., will remove the stock and facilities from the old shop at Green Island.

Henry Guenther will build a foundry at San Antonio, Tex., in connection with his machine shop. His plant at Owensboro, Ky., will continue in operation.

The Fuller Mnfg. Co. will remove from Kansas City to East Moline, Ill., and will erect a foundry and other buildings for manufacture of its disc grain drill.

Penjamin Nichols & Son, Jamestown, N. Y., are enlarging their machine shop by an addition 16x75 feet, and intend soon to increase the foundry capacity.

The Adolph Leitelt Iron Works, Grand Rapids, Mich., are being rebuilt. The work on boiler, pattern and machine shop, to repair fire damage, will cost $7,000.

The St. Joseph Iron Works Co., St. Joseph, Mich., brick structures 45x62 feet, two stories, 55x62 feet and 50x80 feet, for machine shop, foundry and engine rooms.

The Buffalo Pitts Company, of Buffalo, N. Y., is removing its foundry department to a two-acre tract known as the Kellogg Iron Works, and recently bought by the company.

An addition to the wheel foundry of the Pennsylvania Railroad Company, at Altoona, is projected. Its opperation will add 100 wheels per day to the capacity of the plant.

The Ellwood Foundry Co., Ellwood City, Pa., will erect a plant, and among other buildings will be a foundry 50x85 feet. They will make gas engines and general machinery castings.

Williams, White & Co., whose foundry was recently burned at Moline, Ill., have built a new foundry 240 feet long, with cranes covering the entire length, and run by electricity.

The Michigan Malleable Iron Co.'s plant at Delray, a suburb of Detroit, Mich., is about ready for operation. This great concern occupies 6 acres of ground. It will be operated by electricity, furnished by the company's own plant.

The Singer Manufacturing Company, who, some time ago, bought the plant of the Economist Plow Company, at South Bend, Ind., has erected an immense foundry for sewing machine work on the ground, and it is nearly ready for operation.

A receiver has been appointed for the Hanover (Pa.) Foundry and Machine Works. Attorneys of David W. Torry, deceased, claimed that the company was insolvent. The capital stock, $49,900, all paid, is lost, and other liabilities amount to $120,334. Assets estimated at $102,900.

The Michigan Heater Company, Detroit, Michigan, having outgrown its old factory, has under construction a new plant at Weideman place, near Harper avenue. The molding room is to be 100x102 feet, store room, 36x128 feet, and other buildings in proportion. They have contracts to furnish castings for several Detroit firms who formerly got their castings from other cities.

The Curtis & Co. Manufacturing Company have secured acontract to furnish the

Madison (Ill.) car wheel works of the Missouri Car & Foundry Company with a complete overhead trolley system, to be operated by compressed air. It will include molding cranes and pitting cranes, and will be used in handling the red-hot car wheels as well as the molten metal. The Curtis people are also furnishing them a pneumatic turning device for the big receiving ladle, two pig iron hoists, a car wheel breaker, etc. The company have all they can do in this department, their orders local and foreign taxing them to their utmost capacity.

Fires and Accidents.

Marshall's foundry, Pittsburg, Pa., was damaged $200 by fire.

Hennessey's foundry, at Bellefontaine, Ohio, was partly destroyed by fire.

The Obrien Foundry, at San Francisco, Cal., was damaged $8,000 by fire, Oct. 14.

The Dutcher foundry, Milwaukee, Wis., was damaged to the extent of $1,500 by fire.

Robins & Myers' foundry, at Florenceville, Ohio, was damaged by fire, $2,500; insured.

The B. F. Sturtevant & Co. Foundry, at Jamaica Plain, N. J., was slightly damaged by fire.

The Syracuse (N. Y.) Malleable Iron Works was damaged $10,000 by fire, Nov. 17; insured.

The foundry and fuel rooms of the Kerr-Murray Co., Ft. Wayne, Ind., was damaged $5,000.

The Kutztown (Pa.) Foundry was burned December 10. Loss, $70,000. Many valuable patterns were lost.

F. T. Warfield's foundry, Gardner, Mass., had the roof of the boiler and cupola rooms burned off.

The Garrettsville Foundry & Machine Works, Garrettsville, O., was burned Nov. 24. Loss, $6,000.

Albert Provost, a laborer in the Phoenix Iron Foundry, Providence, R. I., sustained a broken leg.

Josiah Thompson & Co.'s foundry, Philadelphia, was damaged $3,000 by fire; covered by insurance.

The Chicago & Erie Stove Works, at Erie, Pa., was damaged $10,000 by fire Nov. 21; partly insured.

The foundry of the National Iron Works, Spokane, Wash., was burned; loss, $25,000; insurance, $5,000.

Jackson, Church & Co.'s foundry, Saginaw, Mich., suffered a loss of $2,000 by fire; fully covered by insurance.

Philip Myer, Jr., had two fingers broken while at work on the elevator, at the West Side Foundry, Watervliet, N. Y.

Ed. Johnson, an employe of the Western Foundry Co., Covington, Ky., was badly burned on the neck and hands by molten metal.

Frank Cook filed suit for $15,000 damages alleged to have been received while in the employ of the Missouri Car and Foundry Co., last June.

The Union Foundry, at Pittsburg, Pa., was damaged to the extent of $300 by fire, caused by an explosion of hot metal. Two men were slightly burned on the hands.

The Belle City Malleable Iron Works, of Racine, Wis., burned Nov. 22. Its value was $150,000. The loss will be $100,000 on buildings, stock and machinery; insurance, $40,000.

Fire completely destroyed the foundry of the Standard Carwheel Company, Cleveland, Ohio. Several thousand carwheels stored in the works were damaged. Loss, $80,000, partly insured.

The foundry of the Jackson-Church Company, of Saginaw, Mich., was damaged by fire $2,500. The firm was rushed with orders, which makes the inconvenience greater than the loss by fire.

A fire at Marshall's Foundry, Pittsburg, Pa., caused a loss of $200. The fire was started by an explosion of naptha, caused by a workman holding a torch to the mouth of the can to see how much was in it.

Henry Cullen, while operating a saw at the Hubbell Foundry, Pittsfield, Mass., had his arm caught and almost severed, a few shreds only retaining it. The surgeons at the House of Mercy completed an amputation.

Freeman H. Edgcomb, foreman of the pattern room of Walker & Pratt's foundry at Watertown, Mass., while crossing the railroad, on his was home from the shop, was run down and killed. He was 60 years old. A daughter survives him.

Stockholders of the Howard Iron Works, Buffalo, N. Y., hold that their last election of

officers was irregular because the president and secretary refused to allow voting of the 305 shares held by the Howard estate. The court is asked to remove the above officers.

A terrific explosion at the Keystone Foundry Company's works, at Bloomsburg, Pa., broke all the windows in the neighborhood. The men were breaking iron by use of dynamite. A piece struck Frank Levy on the head, and the wound is likely to prove fatal.

James Hassett, a steeple-jack, fell 30 feet, from the smokestack of the Missouri Car and Foundry Co., St. Louis, Mo., and received an injury to the spine of which he may die. In his long experience he has had many bad falls; notably, one of 70 feet, and another of 150 feet! In six other falls he was not seriously injured.

While workmen were taking down a brick wall at Parsons, Rich & Co.'s foundry, at Newton, Ia., S. W. Saylor, a workman, seeing that the wall was swaying, and liable to fall on Mr. Parsons, one of the proprietors, rushed up and tried to brace it with his hands, and he was buried beneath the brick and mortar. His right leg was broken in three places, necessitating amputation.

Albert Reis was probably fatally burned at the foundry of the Missouri Car and Foundry Company, St. Louis, Mo. A ladle containing 1,000 pounds of molten iron was accidentally overturned and Reis fell headlong upon the floor, the iron surging up against his body, and before he could be dragged away (which was done with no loss of time) one eye was burned out, his hands and feet were burned to a crisp, and great holes were eaten into his body. He fainted away repeatedly, and was only sustained by hypodermic injections of powerful drugs. His agonized shrieks were appalling, and the horror of the scene almost crazed the onlookers.

Personal.

Mr. Oscar Lynch has been made superintendent of the Fort Worth (Texas) Iron Works.

John Dary has accepted the foremanship of the New England Stove Foundry, at Taunton, Mass.

Edward M. Lockwood has resigned the superintendency of the Oswego, N. Y., Machine Works.

Bernard Rice, a foundryman and machinist of New Orleans, died in that city October 23, fifty-seven years old.

T. T. Wood has resigned his position as superintendent of the Lakeside Malleable Iron Works, Racine Wis.

E. A. Uehling, of Uehling, Steinbart & Co., has sailed for Europe on business connected with his pig iron casting machine.

Mr. Harris Tabor, of the Tabor Manufacturing Company, sailed for Liverpool on the 12th of November, for a business trip.

J. C. Higgins, formerly of Indianapolis, Ind., has formed a co-partnership with a Mr. Wittenburg, and they will operate a foundry at Des Moines, Iowa.

Frank B. Ward has resigned his position of secretary and general manager of the Michigan Brass and Iron Works, Detroit, Mich., to take effect November 1.

Wm. Victor, who recently removed from Lansing to Grand Rapids, Mich., now has a first-class foundry in operation in one of the Lansing Lumber Company's buildings.

James Fitzpatrick, foreman of the foundry of the Singer Sewing Machine Works, at Elizabethport, N. J., died October 27. He was thirty-eight years old, and had been foreman for fifteen years.

Mr. Jacob J. Keller, for years the foreman of the P. P. Mast & Co.'s foundry, has been promoted to the superintendency of the works. He is succeeded in the foundry by Mr. George Sucher.

P. P. Mast, the millionaire manufacturer of Springfield, O., notice of whose death appears elsewhere, left to Ohio Wesleyan University property valued at $200,000, and to the M. E. Church property worth $50,000. He left his adopted children about $1,000,000.

W. D. Berry, for the past five years superintendent of the brass foundry at the Edgar Thompson Steel Works, of the Carnegie Steel Co., Limited, Bessemer, Pa., has resigned, to take the superintendence of the new bronze foundry of the Fort Pitt Bronze Co., Allegheny, Pa.

Deaths.

John Laird, a veteran iron founder of Canton, O., is dead, aged 93 years.

Charles Hoefinghoff, president of the Hoefinghoff & Lane Foundry Co., of Cincinnati, O., died Nov. 20.

A. J. Boyce, proprietor of the Industrial Foundry & Machine Works, East Liverpool, O., died November 30.

John Laird died at Canton, Ohio, aged 93 years. He built the "Pioneer Foundry," but many years ago retired from its management.

Frederick Furth, secretary of the Vulcan Iron Works Co., of Seattle, Wash., died from heart disease in that city Oct. 19, aged 50 years.

W. M. Wilson, vice-president of the American Steel Casting Co., of Chester, Pa., died in New York City, Nov. 18, from the effects of an operation for appendicitis.

Phineas P. Mast, of Springfield, Ohio, died at his home Nov. 20, aged 73 years. He was principal owner of P. P. Mast & Co., Mast Bros. & Co. and other concerns, including a gas company and a bank.

T. A. Frazer, superintendent of the Wells & French Company, car manufacturers, of Chicago, died Oct. 13 at his home of self-inflicted pistol wound. Sickness and despair probably prompted the deed. He was 50 years old.

Charles H. Knowlton, president and superintendent of the M. A. Furbich Machine Co., Camden, N. J., died in Philadelphia from heart disease. He founded the Furbich machine works many years ago under the firm name of Knowlton & Gage.

Timothy McHugh, one of the oldest foundrymen in Chicago, died Oct. 16 at the Chicago Hospital, from the effects of an operation. He was born in Lincolnshire, England, and came to this country while young. He learned the molder's trade at Cincinnati.

Andrew D. Smith, president of La Belle Steel Co., died at Allegheny, Pa., 78 years old. He was the pioneer in river transportation of coal by barges. He purchased La Belle Steel Works in 1875 and has since conducted them with marked success. He occupied many positions of trust and honor.

James Carmichael, superintendent of machinery of the Harlan & Hollingsworth Co., Wilmington, Del., died in that city on Oct. 8, aged 69 years. He entered the employ of the company in 1850 as a journeyman machinist, and by degrees rose to the position of superintendent, which he had held for many years.

Thomas Glover, the well-known member of the firm of Glover Bros., iron founders, died Nov. 28, at Philadelphia, of inflammation of the brain. A few weeks ago, while passing through his foundry, he was stricken with paralysis and fell, hurting his head. He rallied and resumed activity for a short time before finally taking to his deathbed.

William B. Page, a well-known foundryman of Albany, N. Y., died at his home in that city October 30. Mr. Page was born in the town of Ghent, N. Y., May 13, 1853. His grandfather, Joel, established a foundry in a small York State town in 1826, but some years later moved his home and business to Chatham, N. Y. About the time of Mr. Page's birth the grandfather again moved, this time to Albany, and with his five sons, all of whom were molders, continued the foundry business. Upon the death of the grandfather the business passed into the hands of one of the sons, Isaiah, father of the original of this sketch. Mr. Page was educated in the public schools and Albany Academy, after which he took up the shovel and rammer in his father's shop, learning the trade practically and thoroughly. He afterwards became foreman, and later, as the father's enterprises extended, became manager. In 1883 he was taken into partnership, the firm taking the name of Isaiah Page & Son. After his father's death, which occurred in 1884, he continued the business until 1890, when his younger brother entered the firm, which then took the name of Isaiah Page's Sons. He also secured a continuation of the contract under which his father had for a number of years operated the foundry of the Delaware, Lackawanna & Western R. R. at Scranton, Pa., and acquired his father's interest in the Page & Sill "Albany Malleable Iron Works." Mr. Page was an indefatigable worker and threw all his energy into any enterprise with which he was connected. He represented his Assembly district in the Legislature of 1888-90 and made an excellent record. Politics were not to his liking, however, so he refused a renomination. He was the first president of the Commercial Union Co-operative Bank, a trustee of the Albany County Savings Bank, a director of the Commerce Insurance Co., and at one time was secretary of the C. W. Hunt Co., of New York. He was married in 1885 to Miss Alice Graham, of Philadelphia. He is survived by his widow, mother and a brother, who have the heartfelt sympathy of a large circle of friends.

Everything Lost.

The offices of the "Locomotive Engineering" Publishing Company were burned Sunday night, December 4, and everything was lost, including the mailing list. The company wishes to make request through our columns that all subscribers send at once their names, addresses and date of expiration of subscriptions, so that they may not miss any of the numbers.

The company has our earnest sympathy, and we hope that their subscribers will comply promptly with above request.

The S. Obermayer Company.

The S. Obermayer Company, Cincinnati, O., and Chicago, Ill., report excellent business. They have recently filled several large contracts for foundry equipments, and are now working on several big orders for early delivery. In addition to their large regular trade they have filled many government orders during the past year.

Their export business has been heavy; greater than for many years past. They send their general catalogue for the asking.

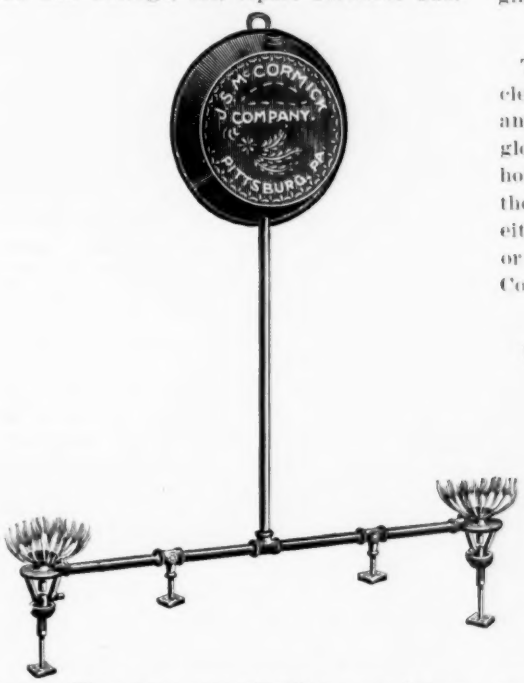
Coring Small Holes.

A correspondent wishes to know how to cast a hole 3-16" diam. at one end and 1-16" at the other, 2¼" through a casting of 7-16" diameter. Any of our readers who can enlighten him will confer a favor by doing so through THE FOUNDRY.

Catalogue No. 23 of the Chambersburg Engineering Co., Chambersburg, Pa., is a 6x9-inch book illustrating the numerous hydraulic riveting machines made by the company; also hydraulic cranes and accumulators. The company makes a great variety of hydraulic machines, and wishes to furnish photographs or prints for any requirement upon request. A special feature of their business is the designing and constructing of machines to suit any particular work that the customer may require. They make steam hammers of any desired size, and steam engines of many styles.

Let Us Have Light.

The balmy summer days, with the bright clear morning and evening are departing, and in their place we have darkness and gloom during the early and late working hours, and not infrequently all day. To get the best work out of your employes you will either have to furnish them with eye-glasses or artificial light, and the J. S. McCormick Company can supply you the latter



in any amount. They have them in use in many foundries, machine-shops, blacksmith shops, rolling mills, factories, warehouses, etc.

The cuts illustrate two styles of lights, both double burners, and they supply the same kinds in single burners also. It will be seen that the larger one is a hanging lamp, while the smaller is for universal use—to hang up, to carry in the hand, or to set wherever needed.

If you want prices, state quantity desired in a letter to the makers, J. S. McCormick Co., Pittsburg, Pa.

NOTICE!

Advertisements in this column, 30 cents a line for each insertion About seven words make a line. The Cash and Copy should be sent to reach us not later than the 20th to insure publication.

Answers addressed to our care will be forwarded.

TO SUBSCRIBERS

whose names appear on our **subscription** list, we will give one free insertion under this heading to those in want of positions, the advertisement to occupy a space of not more than five lines. Additional space or insertions must be paid for in advance at regular rates.

WANTED.—A second-hand five-ton wooden crane, about twelve feet gaff. Address, J. W. Paxson Co., Philadelphia, Pa.

WANTED—To correspond with a party capable of taking charge of a foundry making furnaces and boilers. Address E, Box 186, care of THE FOUNDRY.

FOR SALE.—One number six, one number four, one number three Baker Pressure Blower, in good condition; second-hand. Apply to J. W. Paxson Co, Phila., Pa.

WANTED—Position as foreman of foundry; am familiar with melting and general foundry processes; temperate, married, 36 years old. Address Box 197, care THE FOUNDRY.

WANTED—A company or party with capital to manufacture an invention of merit—a specialty in iron line. Investigate. Address Deane Cox, Box 195, care THE FOUNDRY.

WANTED—Position as superintendent of foundry making light specialty work; 17 years' experience, 5 years on iron shoe lasts and stands. Address Fred P. Olds, Plymouth, Ohio.

WANTED—To correspond with reliable firm in need of foundry foreman, or who contemplate making a change in early part of coming year. Address Confidential, Box 196, care THE FOUNDRY.

WANTED—A first-class, up-to-date foundry foreman wishes to correspond with parties who contemplate making a change. Am strictly temperate and steady. Address Box 191, care THE FOUNDRY.

WANTED—Position by practical foundry foreman; well posted in mill, mining, pumping and general machinery; also in mixing and melting of irons. Good references. Address Box 198, care THE FOUNDRY.

FOUNDRY FOREMAN—A bright young man, 31 years old, pattern-maker and molder, would like to take charge of foundry employing molding machines. Capable of laying out work and superintending same. Address, "Machine," Box 158, care THE FOUNDRY.

WANTED—Position as superintendent or manager of malleable or gray iron foundry by competent man; technical education; 20 years' practical experience; can build or remodel entire plant; experience in East and West. Address Box 194, care THE FOUNDRY.

WANTED—To sell controlling interest in stove foundry, or would take partner, at from five to fifteen thousand dollars; old established business and making money. Either office man or practical foundryman; ability needed more than money. Address C. M. R., Box 192, care THE FOUNDRY.

WANTED.—Position as superintendent or foreman of foundry. Have had 25 years experience in handling men, making all classes of loam, dry and green sand castings; air furnace expert; mixture for rolls, hydraulic machinery and ammonia fittings a specialty. References. Address, Box 180, care THE FOUNDRY.

WANTED—By a metallurgist, eminently successful in thorough laboratory work and in its practical application in foundry practice, permanent position. Chilled, soft and specialty castings to specifications with economy. Laboratory for sale to employers. Can influence orders for paying special work. Address Box 163, care THE FOUNDRY.

WANTED—A foundry foreman, must understand mixing metals, must also be a practical molder and understand thoroughly the making of small grey iron castings cheaply. Must be familiar with machine molding. Only reliable, capable and sober man wanted. Reply, giving age, experience and references; also, amount of salary expected. Address Small Castings, Box 185, care THE FOUNDRY.

FOR SALE—One 72-in. cupola with stack; No. 9 Buffalo blower; 56-in. Boston blower; No. 6 Sturtevant fan and No. 4 Roots blower; one 4-ton foundry ladle; one 10-ton and two 2-ton hand jib cranes.

WE MANUFACTURE GRINDING AND MIXING PANS FOR PIPE FOUNDRIES, FOR GRINDING BRASS ASHES, ETC. THOMAS CARLIN'S SONS, ALLEGHENY, PENN.

FOR SALE—A foundry and machine shop, situated in Phillipsburg, N. J., on the banks of the Delaware River, directly opposite the city of Easton. Business established in 1872; capacity of foundry, 8 tons per day; machine shop equipped with modern tools and patterns; lot fronts on Pennsylvania R. R., 180x264 feet deep; shop makes a specialty of manufacturing the Telegraph Fodder Cutter. Address, Vulcan Iron Works, Phillipsburg, N. J.

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